October 19, 1933

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Engineering News-Record

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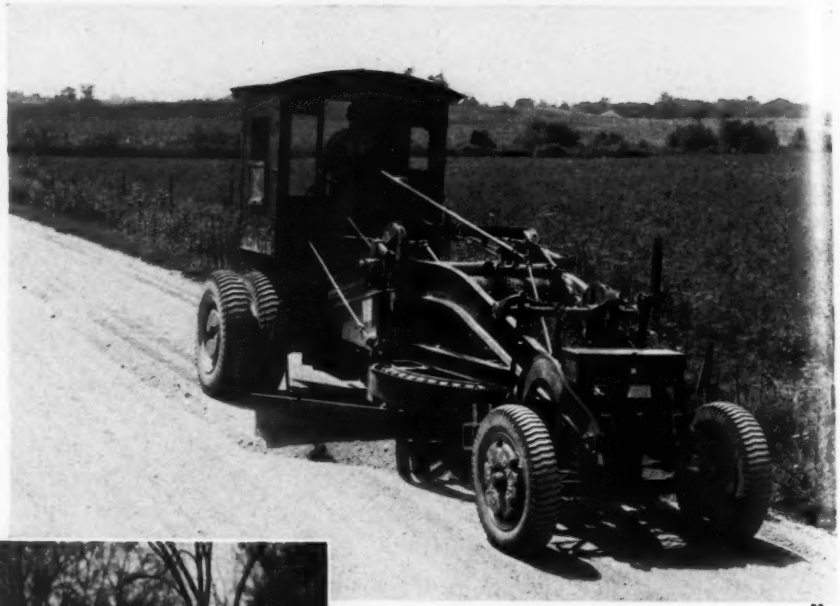

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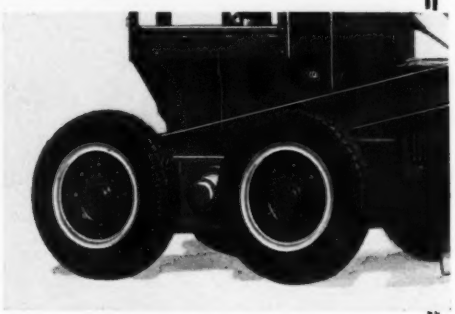

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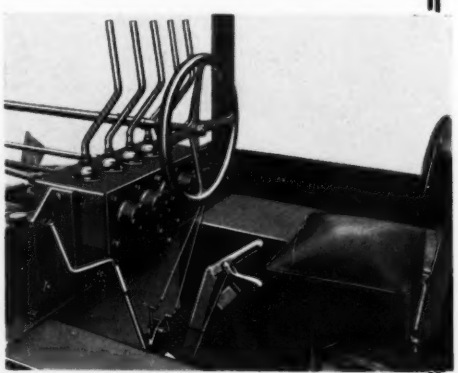

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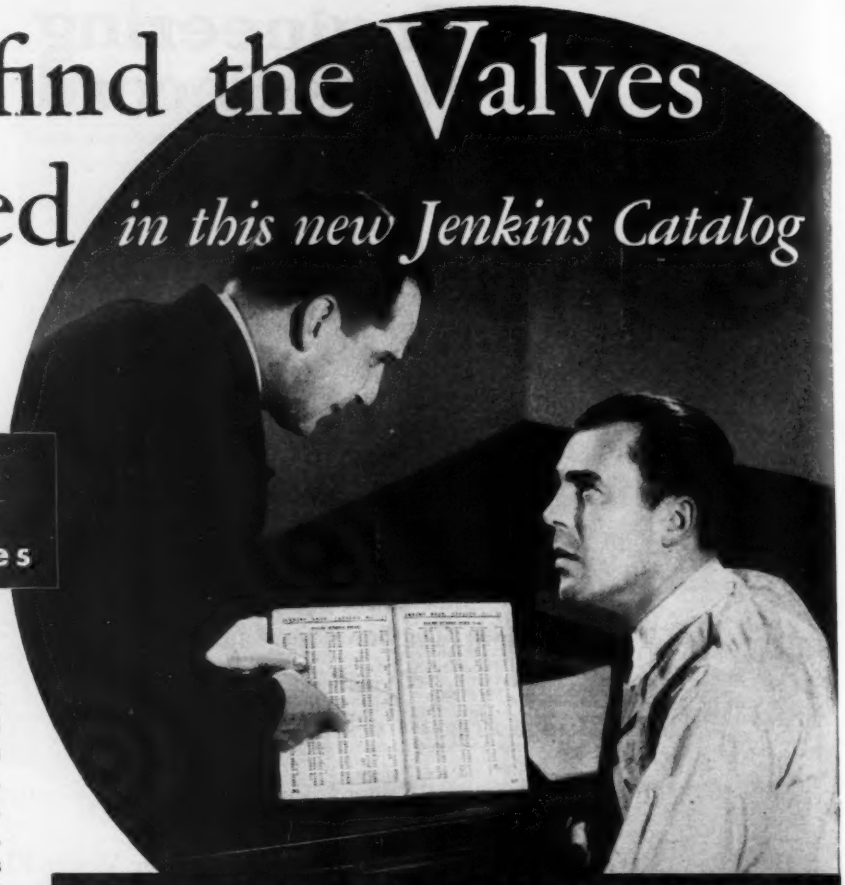

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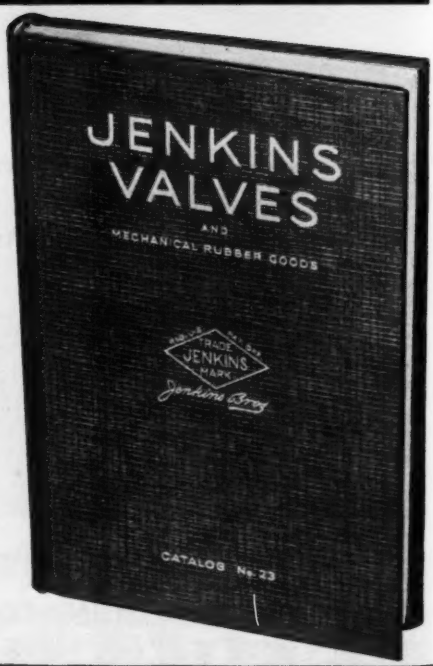

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The New Seventh Street Trafficway in Kansas City, Kansas

Extensive improvement through heart of city provides a bypass around Kansas City, Mo., and includes bridges over both the Kansas and Missouri Rivers as well as long viaducts over industrial districts—Bridge piers founded on steel H-piling

By LaMotte Grover
Office Bridge Engineer, State Highway Commission, Topeka, Kansas

AN IMPORTANT traffic relief artery requiring a total expenditure on the part of all agencies involved of about $4,000,000 is under way in Kansas City, Kansas. Briefly, the intent of the program is to extend and improve Seventh St., and convert it into a bypass and shuttle route to serve the various state highways of Kansas and Missouri that enter Greater Kansas City (Kansas City, Kansas, and Kansas City, Mo.) from the north, west and south. The completed improvement will provide for the interchange of traffic on these routes without its entering the congested sections of Kansas City, Mo., and it will also facilitate traffic movement within Kansas City, Kansas.

The work includes a number of engineering construction projects of considerable magnitude. Near the south end of the route (Fig. 1) the Kansas highway department is completing a new free bridge and viaduct over the Kansas River and the adjacent industrial district on the north bank, at a cost of $450,000. At the north end of the route, a $600,000 self-liquidating toll bridge is being built across the Missouri River. Within the city, Kansas City, Kansas, is widening and straightening Seventh St., and improving connecting streets and boulevards, while the highway departments of both Kansas and Missouri are planning to build new roads and improve others to provide efficient approaches at either end of the improvement.

The Missouri River bridge project is particularly meritorious because at present there are only two highway crossings (within a few blocks of one another in Kansas City, Mo.) between Leavenworth, Kansas, and Independence, Mo., a distance of more than 50 miles by highway. Neither of the existing bridges is exclusively a highway bridge, railroad traffic being carried on a lower deck. To serve the new bridge on the north, the state of Missouri now has under construction a cutoff for state highway 59 and is planning to construct an extension to US 69; from the junction of these two routes a new road will be built to the north end of the Missouri River bridge with an overpass on the Burlington Railroad tracks (Fig. 1). The extension to route US 69 will also provide access to the bridge from US 71, the main north-south highway. From the south approach a cutoff is to be provided by Kansas City, Kansas, leading directly to the packing-house industrial district near the mouth of the Kansas

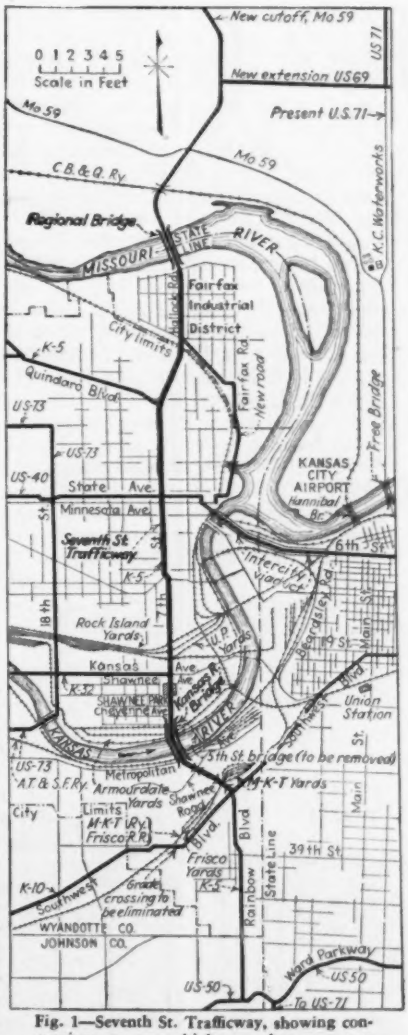


Fig. 1—Seventh St. Trafficway, showing connections to state highways that now can bypass Kansas City, Mo. (shown east of state line).

River and as far as the stockyards district.

In Kansas City, Kansas, the Seventh St. Trafficway is intersected by state highways 5 and 32 and US 40. State highway 10, on the south side of the Kansas River, enters the city on Southwest Boulevard, which also provides access to the Seventh St. Trafficway for routes US 73 and US 50. When the Seventh St. Trafficway improvement is extended, as planned for the future, it will intersect US 50 and also provide a connection to US 71 on the south side of the city. Thus practically every major highway entering both Kansas Cities from the north, west or south will be served by the new improvement.

Kansas City, Kansas, has already expended about $2,000,000 for widening, straightening and surfacing Seventh St. from Quindaro Boulevard south to Kansas Ave., for the construction of a viaduct over the Rock Island Railroad yards and industrial district just north of Kansas Ave. and for a part of the south approach to the Kansas River bridge. The latter includes a steel-rib deck arch structure to carry Shawnee Road over the Seventh St. Trafficway where the latter is in deep cut. Work which the city now has under way to complete this south approach will cost about $50,000. It is estimated that an expenditure of $75,000 will be necessary to improve Seventh St. from Kansas Ave. to Cheyenne Ave. at the north end of the approach to the Kansas River bridge, including the opening of an entirely new right-of-way for one block through Shawnee Park. Also, in order to complete the improvement as far as Southwest Boulevard, a $300,000 viaduct is to be constructed a short distance south of the mouth of the cut under the Shawnee Road overpass. This viaduct will carry traffic over the M.K. & T. and Frisco railroad tracks and Turkey Creek in the Rosedale industrial district. The plans which have been prepared provide for a structure of 1,574-ft. total length, consisting of a series of steel deck-girder spans, with concrete retaining-wall sections at either end. The longest span is 113 ft., located over Turkey Creek. A 40-ft. roadway and one 5-ft. sidewalk are to be provided.

In the following summary the various parts of the general improvement are tabulated, with their approximate costs:

Completed	
Straightening, widening and surfacing Seventh St. from Quindaro to Kansas Ave., including Rock Island viaduct, and part of south approach to the Kansas River bridge	$2,000,000
Total completed work	$2,000,000
Under Contract	
Kansas River bridge and viaduct	$ 450,000
South approach to Kansas River bridge	50,000
Missouri River bridge	600,000
Total under contract	$1,100,000
Proposed for Immediate Construction	
Missouri approaches to the Missouri River bridge including viaduct over Burlington Railroad	$ 225,000
Kansas approaches to the Missouri River bridge and connection to city improvement	200,000
City street improvement from Kansas Avenue to Cheyenne Street	75,000
Turkey Creek, M.K.&T. & Frisco viaduct	300,000
Total for immediate construction	800,000
Grand total	$3,900,000

The total length of the improvement from the Missouri River to route US 50 is about 8½ miles. It is evident that, when completed, it will be of great value to intra-city traffic, since it provides a through-street across the entire city from the Fairfax industrial district on the north, down through the Quindaro Boulevard business district, through the main business district in the vicinity of Minnesota Ave., through the Central Ave. and Kansas Ave. business districts, through the Armourdale industrial district on the north side of the Kansas River and through the Turkey Creek or Rosedale industrial and business district located between the high south bank of the river and Southwest Boulevard. Across Southwest Boulevard, it will connect with the city boulevard system, serving the residence district of Rosedale and the outlying suburban districts to the south. A very abrupt rise in the ground along the south side of Southwest Boulevard throughout a great part of its length through Rosedale has always presented a serious barrier to the construction of direct traffic routes from the south.

Fig. 2. Missouri River bridge is a through cantilever structure. It is the only exclusively highway bridge between Leavenworth, Kansas, and Independence, Mo., a distance of 50 miles. The Hannibal Bridge and the Armour-Swift-Burlington or Free Bridge, near by in Kansas City, Mo., are combined railway and highway structures.

Missouri River Bridge

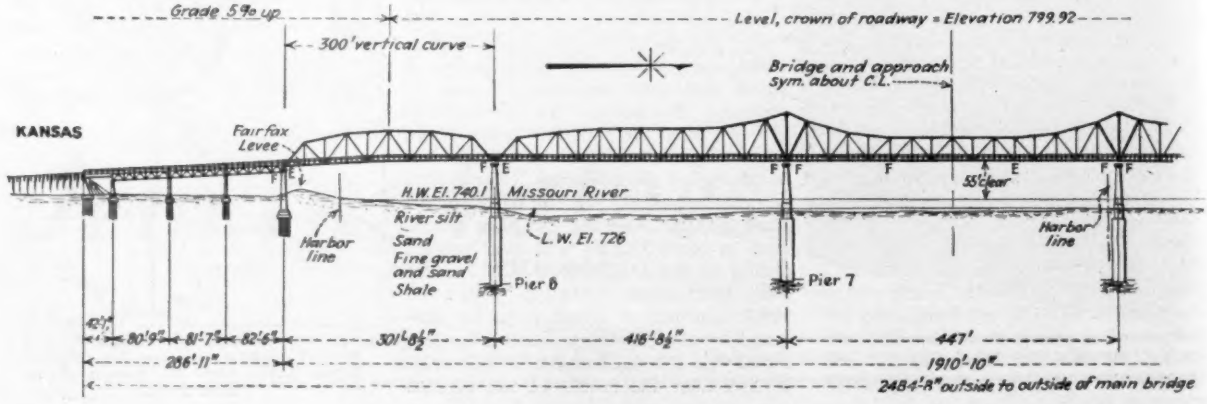
The Missouri River Bridge is being financed by loans from the Reconstruction Finance Corporation secured by revenue bonds issued by the Regional Bridge Co. of Kansas City. The river crossing consists of a three-span through-type cantilever with a 474-ft. central opening (176-ft. suspended span and 149-ft. cantilever arms) and 417-ft. anchor arms flanked by 301-ft. simple through-truss spans (Fig. 2). The approaches consist of deck-truss and deck-girder spans. The width of roadway will be 20 ft. In the main span the suspended portion is 176 ft. long. The trusses are 68 ft. deep over the main piers, 45 ft. at the end of the anchor arms and 32 ft. at the center of the suspended span.

The construction of the piers of the main river crossing has been started. These piers are to be carried to rock, and conventional-type pneumatic caissons and floating equipment are being used. Drawings show rock at about 100 ft. below low-water level. The bridge provides a 55-ft. shipping clearance.

The floor system consists of 33-in. floor beams and six lines of 24- to 28-in. wide-flanged stringers on top of which 10-in. cross-beams are placed to support the floor slab, which is 4¾ in. thick and weighs only 63½ lb. per sq.ft. A welded mat of bars is utilized for the top negative reinforcing and small split I-beams or T's for the bottom tensile reinforcing.

Kansas River Bridge

The first of the major connecting links of the improvement to be completed is the bridge over the Kansas



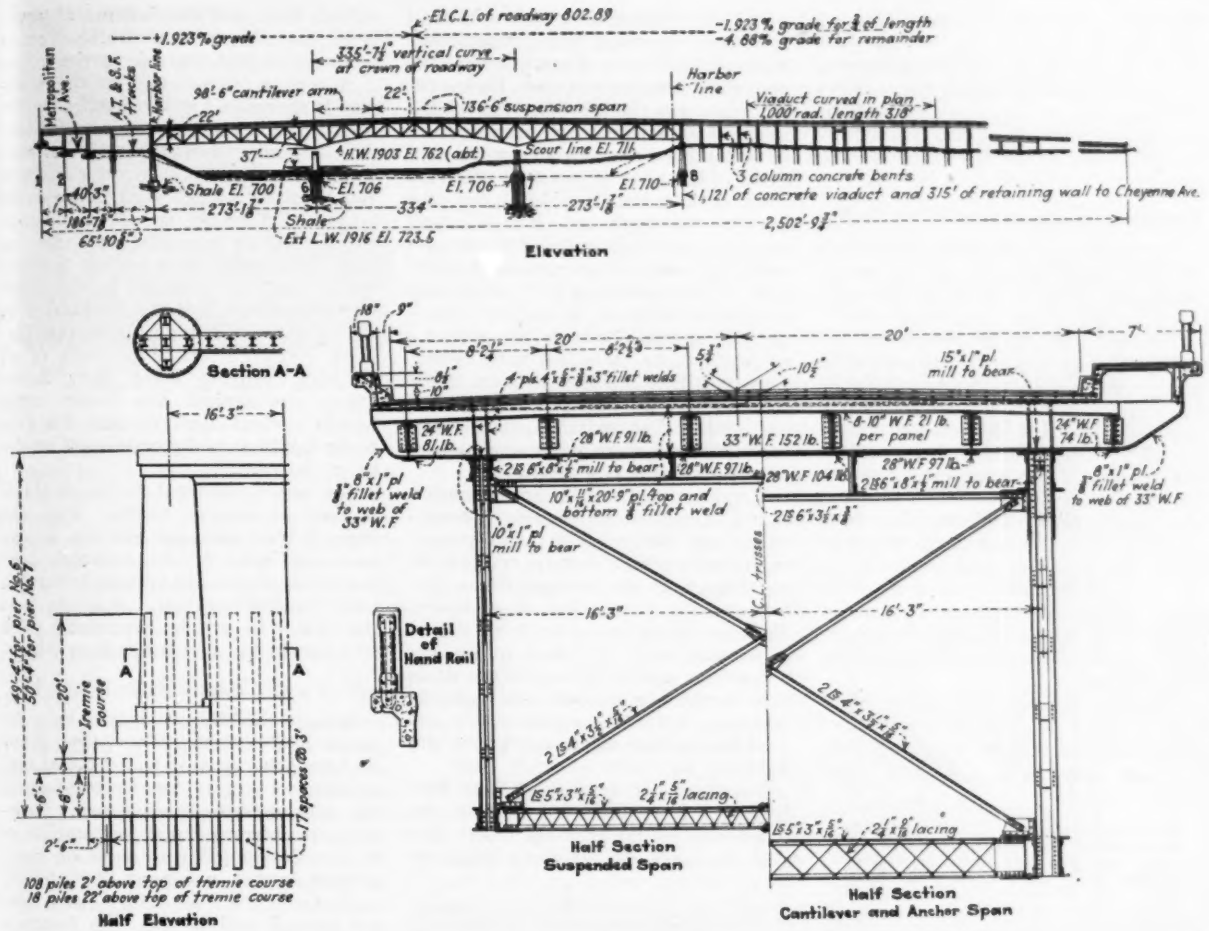


Fig. 3. Elevation and details of new Kansas River bridge. Its long north approach of concrete girder spans crosses the Armourdale yards of the Kansas City Southern and Kansas City Terminal Railways. An important feature of its design is the use of steel H-piling under the river piers.

River with its long north approach viaduct in the Armourdale industrial district and its short south approach which passes over the main-line tracks of the Santa Fe Railroad and Metropolitan Ave. which lie between the high and low banks of the river. Metropolitan Ave., which now provides access to the old Fifth St. Bridge that is to be removed, will be relocated so as to serve traffic from Argentine bound for the new bridge. As shown in Fig. 3, the river crossing consists of a three-span Warren-type steel deck-truss cantilever group, a layout largely determined by the horizontal and vertical clearance requirements of the War Department and by the stipulations of the board of directors of a local drainage district. The main span, including 99-ft. cantilever arms and a 136½-ft. suspended span, has a length of 334 ft. Anchor arms are 272½ ft. long and heavy enough to prevent uplift or negative reaction at their outer ends. The structure is fully riveted throughout. The south viaduct approach, about 186 ft. long, consists of simple, reinforced-concrete deck-girder spans. The north viaduct approach, 1,436 ft. long, includes a series of simple reinforced-concrete deck-girder spans of varying length and degree of skew because of existing and future railroad tracks and driveways. A 40-ft. clear roadway and one 5-ft. sidewalk are provided throughout the length of the structure, with no provision for access to either except at the extreme ends. The total length of the structure is 2,500 ft.

Bids for the Kansas River bridge project were received on Nov. 28, 1932, as a part of the emergency federal-aid

Fig. 4. In erecting the Kansas River bridge, steel was received on a Santa Fe siding at the south end, lifted to the deck by a locomotive crane and trucked out to the erecting derrick. View shows start of suspended span.

highway construction program of 1932. The completion date was set for June 30, 1933, to conform to the requirements of the Emergency Relief Act. When the extension of time was granted by Congress for all emergency federal aid projects, the completion date was advanced.

Design features, Kansas River Bridge

The structure is designed for a standard H-20 loading, using a basic structural-steel stress of 18,000 lb. per sq.in. and increasing the size of members, where necessary, to provide for a 100 per cent increase in gross live load without exceeding a basic stress of 24,000 lb. per sq.in. Such an increase in concentrated wheel and axle loads was not assumed, however, for the design of the floor slab and its immediate supports. Allowable working stresses for silicon steel are 40 per cent greater than those stated above for carbon steel. The floor system is of carbon steel, while silicon steel is used for most of the truss members. Copper-bearing steel is used for the roadway floor-expansion devices because of the difficulty of keeping them well painted.

The shape and depth of trusses which were adopted to provide the required underclearance without involving steep approach grades or departure from deck-type construction, resulted in short stiff truss members and comparatively high deflections. Consequently, the secondary stresses are quite high since all joints are riveted. In view of the inherently self-limiting character of such localized secondary stresses and their effect upon sections of the type used, it was not considered that the effective strength of the members would be materially reduced by the secondary stresses. However, some reduction in the nominal high stresses was probably effected by delaying the riveting of the field joints at the point L_{11} until the anchor arm had been swung, thus permitting a slight rotation of the joint which would relieve a portion of the dead-load secondaries of the members, in which they were computed to be of the greatest magnitude.

The floor of the main spans consists of a 7-in. reinforced-concrete slab supported on 10-in. 21-lb. wide-flanged cross-joists, which in turn rest on the top flanges of the stringers that span between the panel-point floor beams. The cross-joists are curved to the crown of the roadway. This floor system was adopted to provide the minimum dead-load weight consistent with general economy; a 4,000-lb. concrete was also used for the floor slab to assist in weight reduction.

The roadway is divided into four lanes, the outer lanes 10½ ft. wide, the inner lanes 9½ ft., upon the theory that slow-moving, wider vehicles will use the outside lanes and also because observation has shown that traffic has a tendency to hold away from the curbs.

A typical cross-section of the roadway is shown in Fig. 3. Studies by the state highway commission indicated that the combination of double curb and concrete rail would provide greater strength and safety at a smaller cost than could be provided by the use of a handrail constructed on a single curb 10 in. high. The offset between the top and bottom curbs is sufficient to clear hub caps of vehicles, and the total offset to the nearest face of the handrail provides ample clearance for the overhang of all ordinary vehicles when their inside wheels are against the lower curb. Should a wheel climb the curb, the axle of the vehicle would ground itself on the top of the curb.

The design permitted the use of shop-welding in several details. For the fingered floor-expansion devices, it was used with good results, although care had to be exercised to prevent distortion from the welding heat. Welding was also used to attach coverplates and stiffeners to the wide-flange floor beams.

Foundations

Because the bridge is located near the mouth of the Kansas River, deep scour is improbable and it was deemed unnecessary to carry the foundations of the main piers to shale or rock. However, in order to insure penetration of the foundation piling to shale or rock, without damage in driving, 12-in., 65-lb., steel H-piling was adopted. These piles are carried well up into the footings, shafts and webs of the piers. The deepest penetration necessary to enter the shale was at the two north piers; here the required penetration was 53 ft. below the elevation of the bottom of the seal course, and the piling ordered for the southernmost of these two piers was specified to be 81 ft. long. All steel piles were provided with web-reinforcing angles at the tips.

The maximum design load for the steel H-piling is 35 tons each when longitudinal and lateral forces are considered as acting separately and in conjunction with direct vertical loads. Design loads exceed 50 tons when the longitudinal and lateral forces are considered to be acting at the same time. The maximum design load for the timber foundation piling of the viaduct spans was 22 tons.

The design of the concrete viaduct spans involved no unusual features, although the construction was complicated because of the varying span lengths and degrees of skew. At two points where tower spans were needed but could not be used because of railroad clearances, abutment piers were provided. Some of the viaduct spans are provided with convex-concave bearing plates to avoid

Fig. 5. In erecting north half of Kansas River bridge, two erecting derricks were used. View also shows north approach of concrete girder spans under construction.

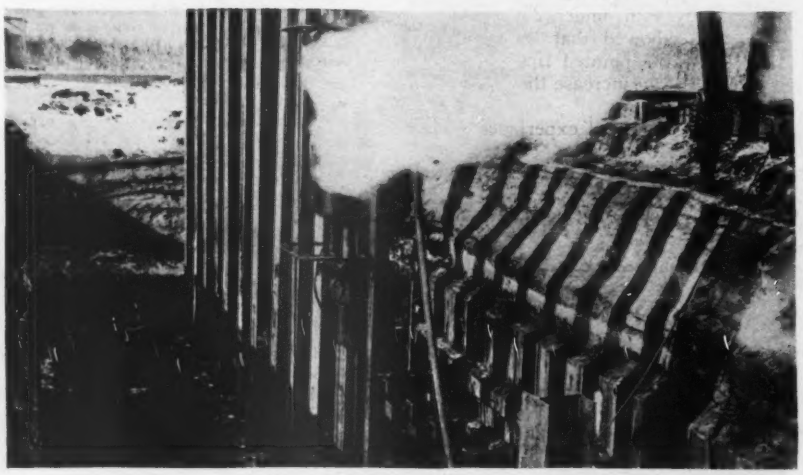


Fig. 6. Steel H-piling driven to support the main bridge piers were kept in alignment by means of guide frames.

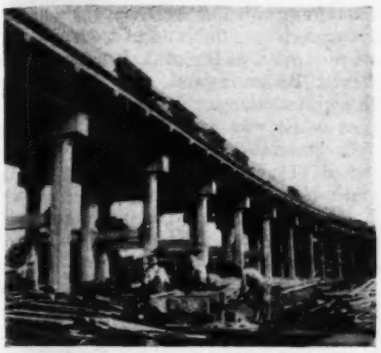


Fig. 7. North approach consists of 3-column concrete bents and concrete girders.

the concentration of bearing that is found in flat plates to accompany the deflection of the girders. The convex-concave contact surfaces are separated by a layer of sheet asbestos to provide free movement. The flat contact surfaces between sliding expansion bearing plates are in all cases separated by a cold-rolled phosphor bronze plate set in the bottom structural-steel plate.

Construction, Kansas River Bridge

Three elements of the construction procedure on the Kansas River bridge varied somewhat from common practices. Steel erection, for example, instead of proceeding from both ends toward the center, as is usual for cantilever bridges, was carried out from one end. Second, driving of steel H-piles is a comparatively new practice for foundations of a bridge of this type. Third, a simple and effective forming system was used for the concrete deck of the bridge.

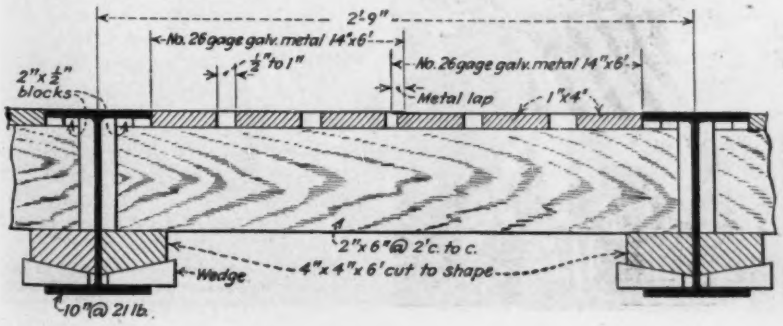
The steel erection plan used resulted from a failure to complete piers 5 and 8 on schedule time, these being the piers under the ends of the anchor arms. Steel erection was started at pier 6 in the center of the river. A traveler was run out on the falsework, which had been driven prior to the construction of pier 6, and, in returning from pier 6 to pier 5, it erected the trusses of the south anchor arm. Steel erection reached pier 5 shortly after its completion. The traveler was then raised to deck level and moved north from pier 5 to pier 6, placing the floor steel. The south cantilever arm was erected next, after which the south anchor arm was swung, and the falsework piling under it transferred to support the suspended span and the north cantilever arm. Erection of these portions then proceeded, with steel supplied from the south end of the bridge where a locomotive crane transferred it from railroad cars to narrow-gage flat cars operating on the bridge deck. A double bent of falsework, well braced, was driven to support the north end of the suspended span so that this span could be swung before riveting the compression chords and also so that the falsework under it could be entirely removed in case of high water. Two travelers were used in erecting the north cantilever arm as well as the north anchor arm which followed it. The north traveler received the bottom chords from the south rig and placed them. The south rig followed up with the erection of the remainder of the steel. No serious difficulty was experienced in using this erection procedure, although the field splices had been arranged for entering the joints in the opposite direction. This resulted in a slight amount of inconvenience.

Steel H-piling was used under piers 6, 7 and 8. It ranged in length from 37 to 81 ft. and was driven to a firm bearing on a coarse compacted gravel immediately above a shale layer, or to the shale when the gravel was not encountered. Guide frames were used to assist in driving, but for the shorter piles that did not extend up into the shafts of the piers the frames had to be removed for the last few feet of driving. No difficulty was experienced in driving. For pier 6, requiring short piling, it was deemed advisable to penetrate the gravel and secure a bearing on the shale. Care was necessary to stop the driving as soon as the pile reached the shale so as to avoid injuring the pile with the No. 0 single-acting hammer used. For the other piers a No. 1 single-acting hammer was used, and it was considered that the pile was well seated when it drove only 1 in. under 25 blows. Experiments showed that the reinforcing angles on the pointed tips of the piles did not greatly increase the resistance to driving.

A rather unusual experience was encountered in driving the steel piles, namely the sinking of the bottom of the excavation from 6 in. to 2 ft. The materials penetrated were mud, sand and gravel.

A very simple form arrangement was used to support the concrete floor slab, as shown in Fig. 8. The forms are composed of 1x4-in. lagging with wide joints tacked to a flexible metal facing that is overlapped at one of the joints between the lagging midway between the steel cross-joists of the floor system. This lagging is supported on 2x6-in. form joists at 2-ft. centers, the ends of which are blocked up and wedged in place between the flanges of the steel cross-joists. An important advantage of such form design is that it can be placed and removed very rapidly. The forms are a product of the Flexible Form Co., Kansas City, Mo., which holds patent rights for the metal-covered lagging feature.

Fig. 8. Forms used for floor concrete on the Kansas River bridge consisted of metal sheets laid on a timber plank-and-joint system wedged up from the flanges of the floor beams.



Personnel

Plans were prepared for the Kansas River bridge by Sverdrup & Parcel, consulting engineers, St. Louis, who were employed by the city to make preliminary investigations before the project was adopted by the state highway commission. The structure was designed to conform to the provisions and standard practices of the state department of bridge design, which is under the direct supervision of the writer and under the general direction of O. J. Eidmann, engineer of design. This department was actively associated in determining and working out the features of the design. The construction of the project is being executed by the Kansas City Bridge Co., H. P. Treadway, president; O. A. Zimmerman, chief engineer, and J. P. Coughlan, superintendent. The structural steel was fabricated by the Kansas City Structural Steel Co., H. A. Fitch, president, and A. M. Myers, chief engineer. The construction is under the supervision of the state highway commission, W. V. Buck, state highway engineer; H. D. Barnes, engineer of construction; H. O. Reed, resident engineer.

The city street construction involved is under the direction of H. F. Schaible, commissioner of streets, and C. E. Peterson, city engineer.

Plans for the Missouri River bridge were prepared by Sverdrup & Parcel, who have also prepared plans for the Turkey Creek Viaduct. Supervision of the construction of the Missouri River bridge for the Regional Bridge Co. is being furnished by the consulting engineers, H. F. Duckworth, resident engineer. The bridge is being constructed by the Kansas City Bridge Co., I. E. Hayes, superintendent. Williard Breidenthal is president of the Regional Bridge Co.

The construction of the approaches within the state of Missouri is under the general direction of T. H. Cutler, state highway engineer.

Bay Bridge Progress at San Francisco

Foundation work actively under way as preliminary operations are concluded—Working platforms ready at several pier sites—First caisson landed and shore pier above water line—San Francisco anchorage site ready for concrete

THE FOUR major substructure contracts on the San Francisco-Oakland Bridge, representing $14,300,000 of work, have all been advanced from the preliminary to the active construction stage during the five months since they were awarded. Along the 4 miles between the San Francisco anchorage and the last pier on the Oakland approach about 1,400 men are at work, with the number steadily increasing as new phases of the work open. Organization of equipment and material has been about completed; large working platforms for several of the deep channel piers in the bay have been erected; sheet-piling work for the shallow piers on the Oakland side is under way; one caisson has been landed on mud in 40 ft. of water; an extension fleet of concrete-mixer barges has been placed in operation; driving of the island tunnel has started, and the San Francisco anchorage has been excavated. The details of foundation design and construction must wait more advanced stages of the work. This review outlines, in general, the present status of this gigantic bridge project.

The bridge, with its total length of about 7 miles, will provide the long-projected direct crossing between San Francisco and the East Bay communities. The structure will be a publicly owned toll bridge built by the California State Toll Bridge Authority and will provide double-deck facilities, including six lanes for vehicular traffic on the upper deck and two interurban tracks and three heavy trucking lanes on the lower. For the general features of the project and its history, see *ENR*, Oct. 20, 1932, p. 457.

San Francisco anchorage

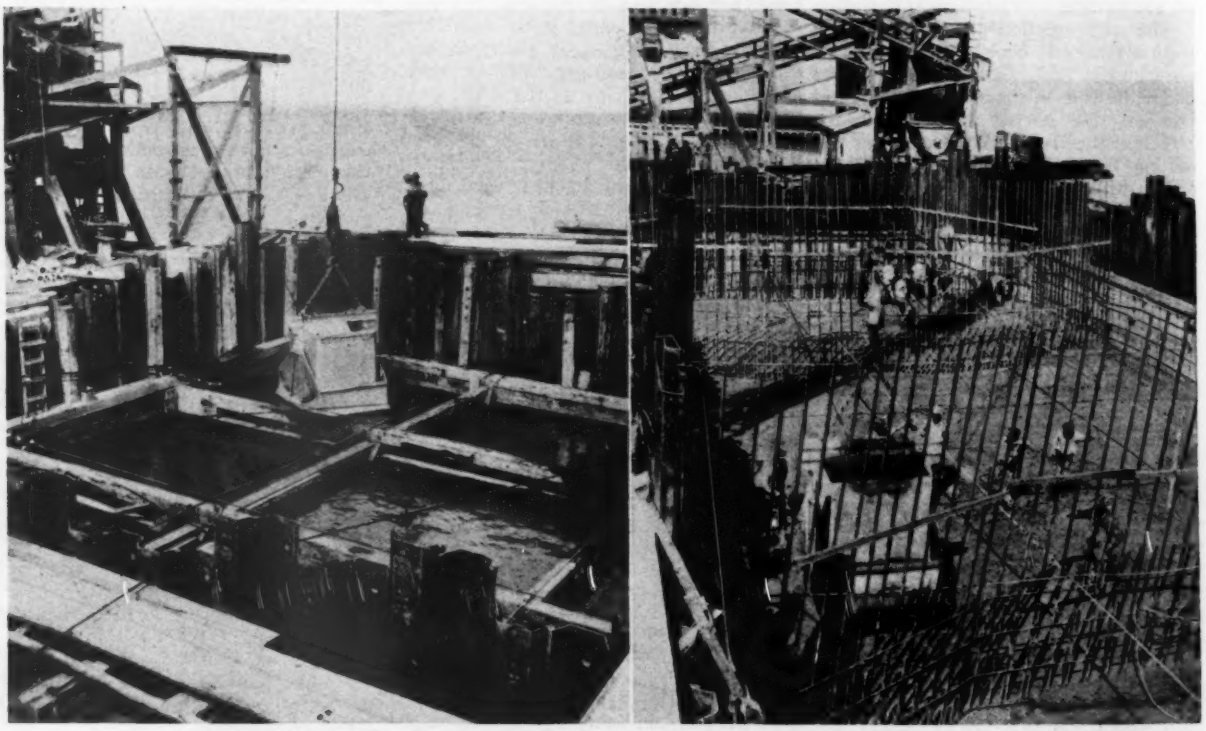
The most westerly unit of the project is the San Francisco anchorage for the cables supporting the 2,310-ft. suspension span which extends to the common anchorage in the center of the west channel, from which point a second suspension span of the same length reaches Yerba Buena Island. Excavation for the west anchorage has been completed. The work was carried on with power shovels and trucks, involving the removal of about 50,000 cu.yd. of earth and rock. Excavation was carried down 5 ft. below the elevation of the original plans to reach solid-rock foundation. Work was carried on in the dry, and no shoring has been required, although minor slides occurred.

In this excavation about 35,000 yd. of concrete will be placed as the erection block, to be followed by about 37,000 cu.yd. of concrete to complete the anchorage. The concreting plant has been completed, and concreting operations should be started Oct. 10. Steel in the anchorage amounts to 1,350 tons.

This contract of $1,036,000, which also includes some approach viaduct, is held by the Healy-Tibbetts Construction Co., San Francisco, of which C. T. Morton is chief engineer and A. Cochrane general superintendent. N. W. Reese is resident engineer.

West channel piers

The substructures for the west channel crossing between San Francisco and Yerba Buena Island include the four tower piers and the comman central anchorage. The first tower (pier No. 2) is located 1,160 ft. from the anchorage on the San Francisco pier-head line and required alterations to the existing wharf and transit shed as a preliminary. After providing a working platform on temporary piling at the site, the con-



Placing the first concrete at pier No. 2 under 90 ft. of water Sept. 10 (left) in 52x122-ft. cofferdam. Three weeks later (right) concreting in the dry at about water level.

tractor floated into position a treated timber frame and drove steel sheetpiling to form the 52x122-ft. cofferdam. With the aid of divers and jetting equipment, the clay overburden was next dredged out to rock foundation. Depth to rock averages about 90 ft. Two steel stiff-leg derricks with 120-ft. booms erected on the working platform handle the excavation and the concrete.

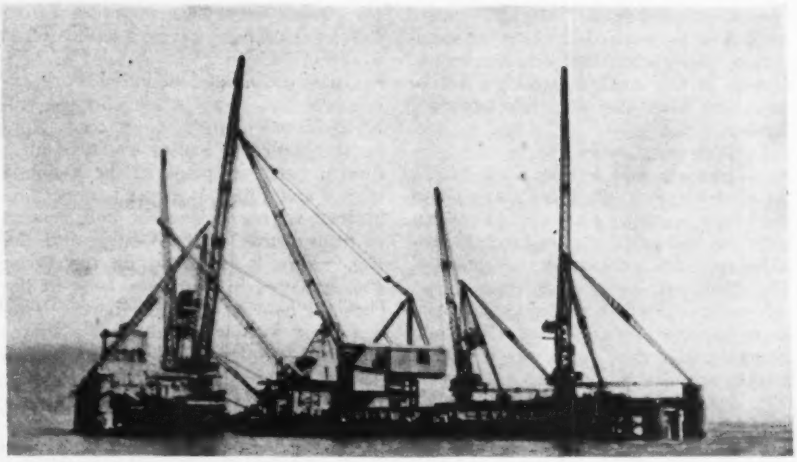
Concrete was placed under water in 4-yd. bottom-dump buckets in a continuous pour up to within about 10 ft. of the surface. The cofferdam was then pumped out, and the last 10 ft. to water line was placed in the dry. After several lifts had extended the concrete to about El. 10, the sheetpiling was pulled and the pier will now be completed to its top at El. 40. Total concrete in this pier will about 21,000 cu.yd.

Work in the channel has been concentrated on preparations for the start on the central anchorage, 92x197 ft. in section at the base, which will extend vertically from El. 180 to El. 300. The caisson for this anchorage will be sunk to rock by open dredging. Water depth at the site is about 70 ft., and the tidal velocity exceeds 3½ m.p.h. The combination of water depth, tidal current and size of the caisson presents an outstanding foundation problem.

Preliminary work at the site has involved the building of working platforms or docks on piles, including special supporting cylinders for the four stiff-leg derricks to be used for dredging and concrete placing. Each of the two docks, 40x180 ft. in plan, rests on four-pile bents at 18-ft. spacing. The piles vary from 120 to 130 ft. long and were driven about 40 ft. into the mud bottom. They are connected at the top (El. 16) with heavy timber framing, and diagonals extend to a second set of bracing timbers at the water line. The deck consists of a 3-in. timber planking laid on the diagonal, with a second 2-in. timber topping laid on the opposite diagonal to provide the lateral stiffness required by the force of the tide.

Within the working dock area are the special foundations for the four derricks. These consist of 8-ft. steel cylinders, three per derrick, driven into the mud and dredged out. After seven timber piles were driven inside each cylinder, it was filled with concrete to the top at El. 25, which is the derrick base level. Timber struts, 24x24 in. in section, and cable ties brace these cylinders together into a foundation unit. The working docks will not be connected to the caisson.

Concrete anchors weighing about 20 tons each will hold the caissons at the central anchorage (pier No. 4) and piers 3, 5 and 6 in position during sinking. These anchors are equipped with pipe outlets along the lower edge and were successfully jetted into the mud until their tops are about 4 ft. below mud line. Twenty-six of these anchors have been sunk to hold the central anchorage caisson. Cables from the anchors will pass through the platforms to the caisson.



Working docks at the central anchorage (pier No. 4) under construction. The four large stiff-leg derricks are the installation for excavating and concreting, in sinking the 92x197-ft. caisson. The two barge-mounted whirler derricks are erecting the permanent construction equipment.

In general, the preliminary work at pier 3 is the same as at the central anchorage except that the working platforms will be smaller, 41x78 ft. in plan, and only two derricks will be provided. At this location and at the central anchorage heavy timber fenders will be used to close the open ends between the working docks after the caisson is in position, to prevent damage from ramming.

At the sites of piers 5 and 6 the water depths are greater, which precludes the use of working platforms. At these sites the caissons will be floated into position and held by anchors, and work will be carried on entirely from floating equipment. Sixteen anchors will be used at pier 5, and 26 at pier 6, where the water depth is 105 ft. and the tide exceptionally swift. The caissons will be inclosed in heavy timber floating fenders, also held by anchors.

Contract for the west channel foundation work is held by the Trans-Bay Construction Co., a grouping of the Pacific Bridge Co., General Construction Co., Morrison-Knudsen, J. F. Shea Co. and McDonald & Kahn. Charles F. Swigert, of the Pacific Bridge Co., is president; Ben H. Cook is general superintendent; and C. P. Dunn is chief engineer. The contract price for this foundation work is $6,957,100. I. O. Jahlstrom is resident engineer.

Island crossing

Construction work on the island consists of providing a cable anchorage for the easterly suspension span, driving and lining a 500-ft. length of tunnel with a cross-section 60x80 ft., and building several small foundations for approach viaduct. Preliminary work required the building of roads to the various working points. The contractor has completed a materials dock on the west side of the island and built a large chute for delivering the rock excavated from the anchorage site and the tunnel to barges for removal to deep water. These preliminary operations have now advanced to the point where actual excavation of the anchorage site and portal cut for the tunnel have started.

This contract is held by the Clinton Construction Co., San Francisco, at a bid figure of $1,821,292. W. B. Brinker is president, and A. Peterson is construction superintendent. H. Carter is resident engineer.

East channel work

The main feature of the east channel section of the bridge is a 1,400-ft. cantilever span over the navigation channel, with 510-ft. anchor arms. There follow to the east five 509-ft. through-truss spans and fourteen 291-ft. deck-truss spans to the beginning of the approach fill. Substructure work for this section can be divided into the seventeen pile foundations in sheetpile cofferdams for the easterly spans, and the caisson work for the three main foundations under the cantilever span near the island.

The contractor is making rapid progress on the driving of the cofferdams at the east end. Equipment and materials will be provided for building four of these piers simultaneously, and, as completed, the sheetpiling will be reclaimed and used successively for the following piers working toward the island. Construction operations will follow the usual procedure: (1) driving a steel sheetpile cofferdam; (2) dredging to the required depth; (3) driving timber bearing piles; (4) placing concrete seal; and (5) unwatering and finishing the pier in the dry. The interesting feature of this foundation program is the use of a steel I-beam fastened directly to every fourth sheetpile to act as a vertical stiffening unit, eliminating the necessity for interior timber cribbing reaching all the way to the bottom. The lower end of the sheetpiling and I-beams will be held in the mud, and the upper end will rest

against a timber frame, leaving the main section of the cofferdam clear for excavation, piledriving and concrete work. Details of this cofferdam design will be described when the work has advanced further.

Caisson foundations are required for three piers in this section of the work. At pier No. E-5, the third pier east of the island, working platforms have been built and two stiff-leg steel derricks provided to handle excavation and concrete. The 60x120-ft. steel cutting edge of this caisson was the first on the entire project to be moved into position. It is held by guide piles and I-beams from which wedges are used to maintain exact position during sinking. Concreting has been in progress for several weeks, and the caisson has been grounded on the mud bottom in 40 ft. of water. Following one or two more 5-ft. lifts of concrete, the false bottoms of the dredging wells will be removed and the usual dredging-and-concreting cycle started. The estimated depth to required foundation is 160 ft.

The next pier toward the island will be practically a duplicate construction operation, and already the working platforms for the derricks have been completed. Subsequently, the equipment from these two piers will be re-used for the sinking of the main cantilever pier caisson, which will go to a total depth of about 235 ft. The pier nearest the island will be built inside a cofferdam and will be founded on rock at a comparatively shallow depth.

Contractors and engineers

Contract for the substructure in the east channel is held by Bridge Builders, Inc., a group of contracting firms including Raymond Concrete Pile Co., Missouri Valley Bridge & Iron Works, Utah Construction Co., Dravo Contracting Co. and Bechtel-Kaiser-Warren Co. Henry J. Kaiser is president of this organization, M. M. Upson vice-president, E. H. Connor managing engineer, and C. B. Jansen superintendent of construction. The contract figure is $4,495,854. V. A. Endersby is resident engineer on the project.

Additional features

One of the interesting sidelights of the construction program is the providing of electric power to all points of the project, particularly the pier sites on the bay. The Pacific Gas and Electric Co. has laid a 12,000-volt submarine power cable along the line of the bridge, with taps adjacent to the pier locations. At the big piers separate transformer banks on the working docks provide power for the derricks and other equipment, including the concrete-mixer barges when they tie up at the pier. For the smaller foundation units transformer banks are provided on separate pile structures for two adjacent piers. The cost of this 18,000-ft. cable installation and facilities is about $60,000, and it is estimated that the electric energy consumption during the construction period will exceed 11,000,000 kw.-hr.

Concrete for all foundation work except the San Francisco anchorage will be furnished to the various contractors by the Henry J. Kaiser Co. through a central batching plant at the Oakland harbor and a fleet of mixer barges. The batched aggregate and the bulk cement is transported by these barges to the site, where it is mixed on the barge and delivered by conveyor belts to the buckets handled by derricks. This equipment is now in use, and a subsequent description will outline its important features.

Plans for comprehensive rearrangement of traffic facilities on both sides of the bay have been studied in detail and are being definitely formulated. In the East Bay the program of new boulevards and widened streets has been completed. No definite plans have been announced for the change in the interurban system, which is now handled by two companies with individual ferry systems. In San Francisco the program will require provision for the interurban terminal and vehicular outlets. Street-widening projects and some changes in existing boulevards are now awaiting financing.

Organization

The San Francisco-Oakland Bridge is being constructed by the California Toll Bridge Authority under the general direction of Earl L. Kelly, director of public works. C. H. Purcell is chief engineer, C. E. Andrew is bridge engineer, and Glenn B. Woodruff is engineer of design. The consulting board consists of Ralph Modjeski, chairman Moran & Proctor; L. S. Moisseiff; Charles Derleth, Jr., and H. J. Burnnier.

Stream-Pollution Survey Completed in Cook County

RECENTLY a two-year pollution survey of 700 miles of streams in Cook County, Ill., has been completed, one of the most extensive of its kind in the country. The survey was carried out by the state board of health, with a view to making the natural waters of the area more available for watering stock and more suitable for recreation, since 75 per cent of the streams border on forest-preserve lands. At present, fish cannot live in the streams and the water cannot be used safely for bathing or for domestic stock. The survey included Salt Creek and the Calumet, Des Plaines and North Branch of the Chicago River and tributaries. It was made at the request of the Cook County stream advisory committee, a group appointed by the county and forest preserve commissioners.

The highly polluted character of the stream now is suggested by the fact that 953 sewer outlets from municipalities, institutions and private dwellings were found to be discharging untreated sewage into the streams. In addition to this, there are 2,498 drainage outlets for stormwater that empty into the streams. At some points the streams have been used for dumping grounds. This was indicated by an abundance of rubbish which contained thousands of milk bottles, empty cans and similar débris. The effect of the pollution on aquatic life was shown by an abundance of dead fish found at different points in the water.

The reports, which carry detailed records of all sources of pollution and are profusely illustrated with maps and pictures, offer specific recommendations for the abatement of pollution and for preserving sanitation in the future.

Recommendations for the North Branch (typical of these reports), were based upon the conclusion that any sewage to be discharged into the stream shall be so purified that it will be clear, contain sufficient dissolved oxygen and have such a low biochemical oxygen demand, that it will be non-putrescible without dilution for a ten-day period and that chlorination of such purified sewage may be advisable at certain places during summer seasons.

Combined sewers are disapproved for new construction, and substitution was recommended of a separate system of sewers that could be installed on a systematic plan within a reasonable number of years. Changes and additions to existing treatment works or the installation of new works are recommended, as engineering and cost studies indicate to be advisable, in order to render them adequate to handle the sewage efficiently and economically. Continuous operation and proper maintenance are set up as requisite factors of the program.

Untreated sewage from private installations is interdicted, and no permits for new outlets for untreated sewage are to be given. Further dumping of garbage and rubbish is also under the ban. The establishment of stream-gaging stations to determine flows is suggested.

The carrying out of these recommendations is to be by education, coperation, persuasion and legal means if necessary. The state sanitary water board, the Sanitary District of Chicago, and the various governmental units each have a part to do if the clean-up is to be accomplished within any reasonable time.

Selecting Pumping Equipment for a Large Water Plant—II

Combination of constant-speed and variable-speed pumps selected to meet the conditions presented by the station load curve—Specifications provide for "evaluating" equipment bids in accordance with guaranteed performances

By William C. Rudd
Assistant Engineer of Power, Department of Water Supply, Detroit, Mich.
and Louis E. Ayres
Consulting Engineer, Ayres, Lewis, Norris and May, Ann Arbor, Mich.

IN A preceding article the reasons were presented which led to the adoption, in the new Springwells Station in Detroit, of motor-driven centrifugal pumps throughout, the motors being supplied with electric energy from a steam generating plant under the same roof with the pumping units. This article discusses the adaptation of a relatively large number of units to the variations in quantities of water required and of the heads to be pumped against, due to hourly and daily load changes and the increase in demand for water over a period of years.

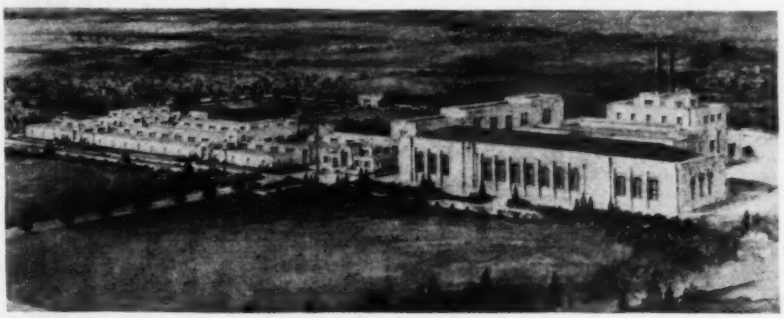


Fig. 1—The new Springwells Station of the Detroit water department. The building in the right foreground is the pumping station, comprising both the low-lift and high-lift plants. Directly behind it are the turbo-generator and boiler plants. The filter plant is to the left of the pumping station, with the covered coagulation basin behind it. The covered clear-water reservoir is in front of the filter plant.

A general plan of the pumping station is shown in Fig. 2. The station contains, in effect, three pumping plants: a low-lift plant, pumping raw water from the supply tunnel to the mixing chamber of the filter plant; and two high-lift plants, delivering filtered water at different pressures into two separated service areas. The low-lift plant contains ten pumping units, two driven by variable-speed motors, two driven by two-speed squirrel-cage motors, and six by constant-speed motors, all together having a capacity, at rated heads, of 435 m.g.d. The high-lift plant will contain ultimately, in both services, sixteen units, four driven by variable-speed motors and twelve by constant-speed motors, and all together having a capacity, at rated heads of 680 m.g.d. The actual total plant capacities, at the operating heads, will be, for reasons to be discussed later, considerably less than these figures.

The steam power plant is to be capable of supplying, through four main and four auxiliary turbo-generators, the maximum pumping demand, and is to be supplemented by a tie-line to central station service, with installed transformer capacity equal to at least that of one turbo-generator.

Low-Lift Plant Units—The low-lift plant, a circular structure having a depth of 110 ft., an inside diameter of 58 ft. 4 in., and an outside diameter, at the top, of about 100 ft. (*ENR*, March 19, 1931, p. 468) contains eight main pumps and two smaller dewatering pumps, both of which are normally in ordinary operating service but are always readily available for the emergency of plant flooding. These units are all of the vertical-type, direct-connected centrifugal pumps and motors. The main pumps are set at El. 65, city datum, which for some years will permit of starting without priming; and the motors are on a floor at El. 100, which places them above maximum high water in the Detroit River at the intake and therefore beyond flooding. The pumps receive their supply from an annular chamber at the bottom of the station, connected to the end of the long supply tunnel, and discharge into vertical concrete conduits in the plant wall and over fixed weirs at El. 132.0.

Head and Load Conditions — Obviously, with this arrangement the variations in pumping head arise mainly out of the changes in water level on the suction side of the pumps and are due: (*a*) to the friction losses through the intake and 11 miles of tunnel, and (*b*) to variations in the level of the Detroit River. Friction loss is the chief variable, accounting for a range in head of about 20 ft. in a range in capacity of 100 to 300 m.g.d.; and the Detroit River varies, from high to low, about 7 ft. The relationship between head and quantity of water delivered is shown by the load curves in Fig. 4, from which it appears that the range in head was expected to be from 40 to 52 ft. at the beginning, from 43 to 59 ft. in 1940, and from 46.5 to 69 ft. in 1950, or a total range over the two decades of 40 to 69 ft. It is expected that between 1940 and 1950 the projected Northeast Station will be constructed and put in service. This will require an increased flow through part of the tunnel system, involving a greater head on the Springwells low-lift pumps. For that reason the load curve at given river elevation is higher in 1950 than it is in 1940.

The quantity demand on the low-lift pumps varies from day to day and may be expected to increase from year to year, but hourly fluctuation is not a factor as it is ironed out by the operations of the filter plant and reservoirs. Estimates made in 1925 of the average annual consumption for the Springwells Station were as follows:

Year	Minimum Day, m.g.d.	Average Day, m.g.d.	Maximum Day, m.g.d.
1931	91	121	164
1940	147	197	266
1950	155	206	278

The minimum day in the above table was taken as about 75 per cent and the maximum day as 135 per cent of the average day.

Parenthetically, it may be stated that the figures quoted above were based on experience up to the time they were made and were believed to be conservative through the fateful year 1929. Obviously, the present situation is far different from what was then anticipated. If one assumes, as most do, that present-day economic conditions are to be adjusted eventually so that normal living will again be resumed, it may then be assumed that the normal water requirements of Detroit and vicinity will again be experienced. The picture herein presented is then affected only in regard to the dates at which the particular requirements will need to be met. It would be as good a guess as any to advance the dates in the foregoing table by, say, one decade.

Fitting the Units—Referring again to Fig. 4, the method used in determining

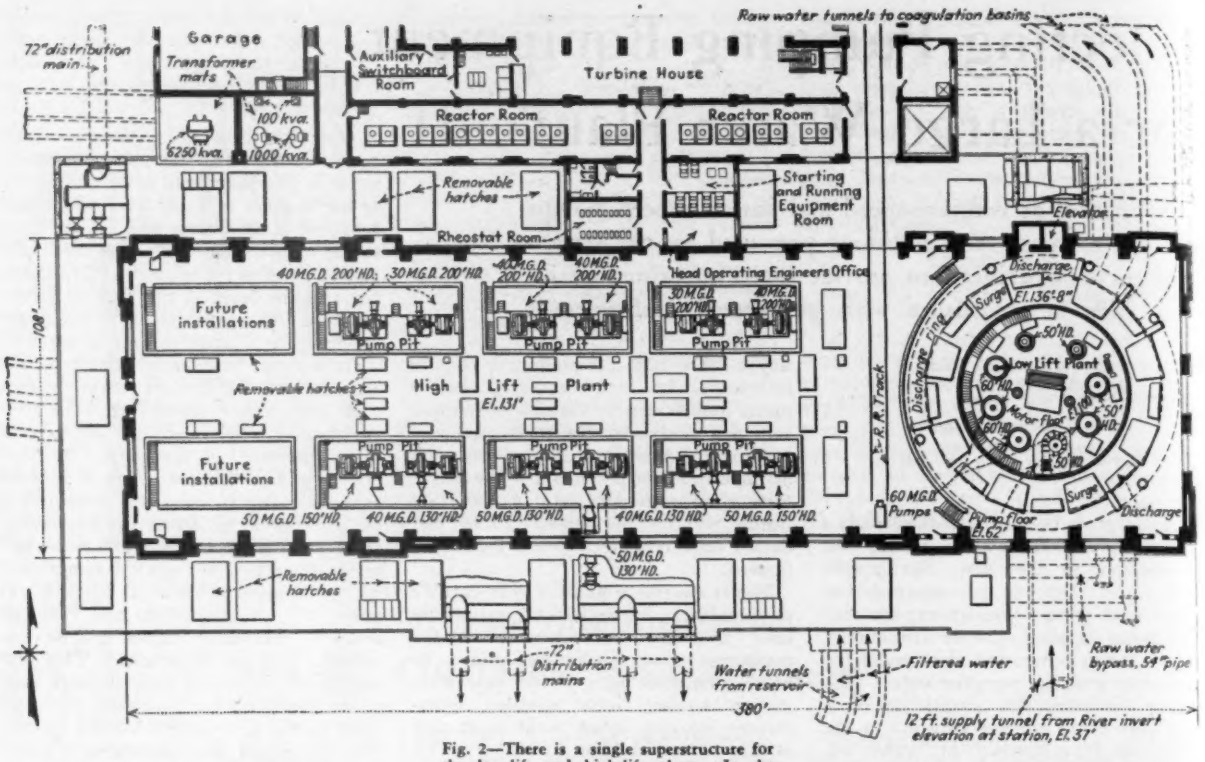


Fig. 2—There is a single superstructure for the low-lift and high-lift plants. In the low-lift plant eight vertical centrifugal pumps, driven by electric motors, are arranged radially in a circular pit. Twelve motor-driven centrifugal pumps are provided for the high-lift plant, set in six rectangular pits. The six pumps on the north side of the station are for the high-service system; the other six are for low service. High-lift pumps at the left receive water directly from the filter plant; those at the right receive it from the filtered-water reservoir.

desirable pump characteristics was to superpose on the load curves known pump characteristic head - capacity curves for different sizes and ratings of pumps, and by trial and inspection to arrive at that combination which seemed best fitted to all the conditions. The pump characteristics shown in the diagram are those of the pumps finally purchased, which were as follows:

No.	Capacity m.g.d.	Head Ft.	Speed
2	30	50	Variable
3	60	50	Constant
3	60	60	Constant
2	7.2	55	Two-speed

The inherent difficulty in the situation is that with the load curves the head *increases* with an increase in quantity, while with a centrifugal pump the head *decreases* with a quantity increase. In order, therefore, to meet the demands of peak load, the installed pump capacity, at rated head, appears excessive. For example, to meet a maximum day of 278 m.g.d., the total installed capacity, at rated head, amounts to 420 m.g.d. in main units, plus 15 m.g.d. in smaller units, or a total of 435 m.g.d. This would seem to provide a reserve of 56 per cent; actually the reserve, if experience proves the head computations to be correct, will be only about 25 per cent.

It is to be observed that the only possible operating points are at the intersections of the head-characteristic curves with the plant-load curves. In Fig. 4 the head characteristics for all combinations of main units are shown when operating at rated speeds. Numerous gaps appear. These gaps are to be covered by the use of the two variable-speed units and also by the use, in regular service, of one of the station dewatering pumps.

To give an idea of the probable operating efficiencies resulting from the several combinations of units, an efficiency curve corresponding to each head-characteristic curve is shown plotted in the figure. From these one may observe efficiencies of from about 75 per cent at minimum deliveries in the earlier years to 83 per cent at average deliveries in future years, all based on manufacturer's guarantees. The pumps selected give maximum efficiency at about average load and fall off more for increased than for decreased quantity delivered.

Low-Lift Pump Specifications — The units were purchased after due advertisement to manufacturers and under very complete and carefully drawn specifications. The principal objectives

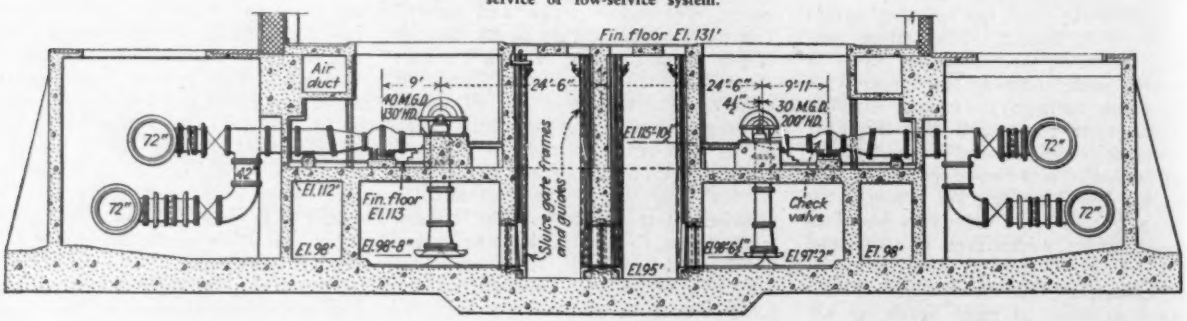


Fig. 3—Cross-section through the high-lift pump pits. A double loop of 72-in. pipe around the plant serves as a discharge header, valved to serve either the high-service or low-service system.

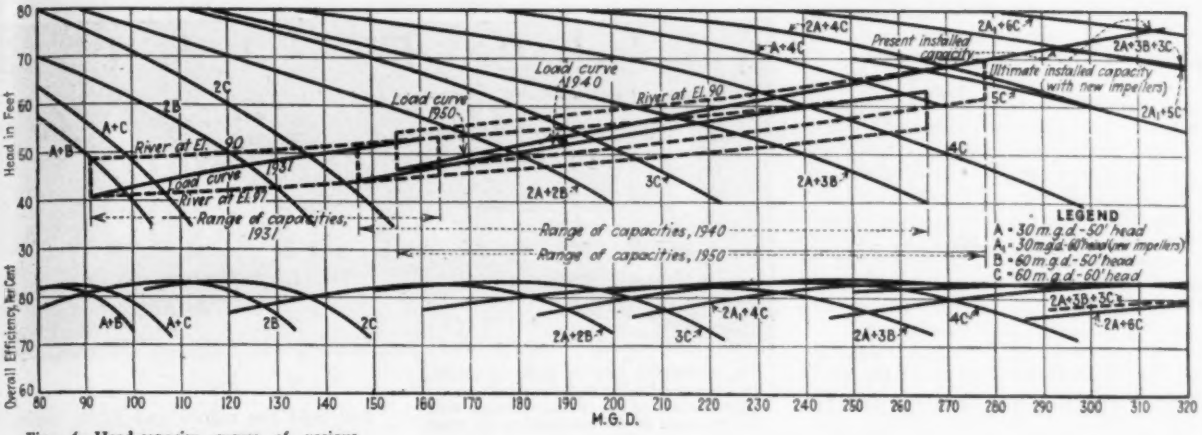

Head in Feet
Overall Efficiency, Per Cent
M.G.D.
Load curve 1940
Load curve 1950
Load curve 1931
River at El. 90
River at El. 91
Range of capacities, 1931
Range of capacities, 1940
Range of capacities, 1950
Present installed capacity
Ultimate installed capacity (with new impellers)
LEGEND
A = 30 m.g.d. - 50' head
A1 = 30 m.g.d. - 60' head (new impellers)
B = 60 m.g.d. - 50' head
C = 60 m.g.d. - 60' head

Fig. 4—Head-capacity curves of various combinations of centrifugal pumps superimposed on the load curve of the low-lift plant serve to indicate the conditions of operation. The head against which the low-lift plant operates depends upon the loss of head in the 11-mile-long supply tunnel and the stage of the Detroit River.

in the minds of the engineers who wrote the specifications may be briefly summarized as follows:

1. Fairly specific head-characteristic curves were desired. Curves as *steep* as might be consistent with good efficiency were necessary to make sure that the total plant capacity would meet the demands of the maximum day. It was also essential that the capacity at rated head should be met.

2. Good efficiency was desired, and every incentive was given to the manufacturers to do their best. In comparing bids definite and liberal allowances were made for efficiency.

3. The Board of Water Commissioners protected itself by exacting proof from the manufacturers as to their guarantees by requiring: (*a*) model tests prior to the manufacturing of the pumps; and (*b*) carefully executed field tests prior to acceptance and payment.

Some of the requirements of the specifications through which the above objectives were obtained are of interest and are outlined in the following paragraphs.

In addition to fixing the capacity at the rated head, a second point on each head-capacity curve for each unit was

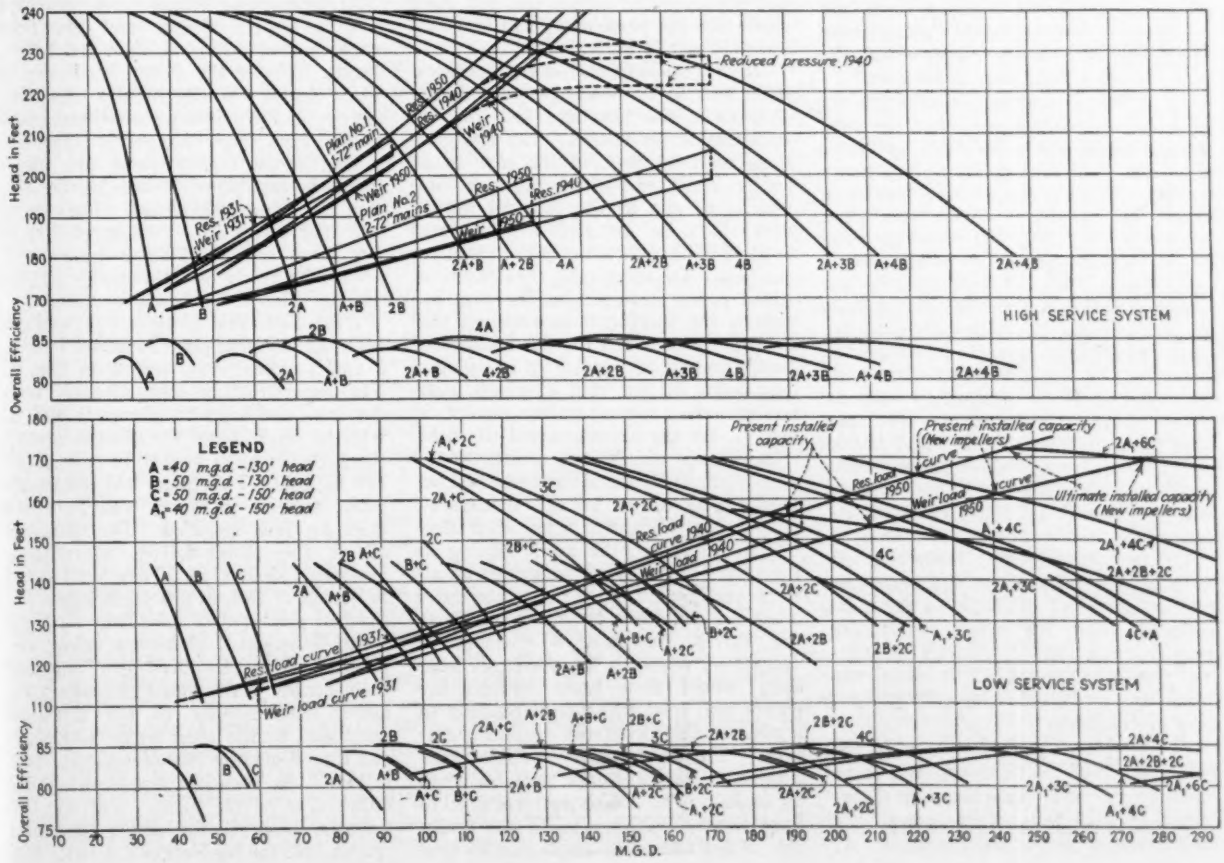

Head in Feet
Overall Efficiency
M.G.D.
Reduced pressure, 1940
HIGH SERVICE SYSTEM
LOW SERVICE SYSTEM
LEGEND
A = 40 m.g.d. - 130' head
B = 50 m.g.d. - 130' head
C = 50 m.g.d. - 150' head
A1 = 40 m.g.d. - 150' head
Present installed capacity
Present installed capacity (New impellers)
Ultimate installed capacity (New impellers)
Res. load curve 1931
Weir load curve 1931
Res. load curve 1940
Weir load 1940
Res. load curve 1950
Weir load 1950
Plan No. 1 1-72" main
Plan No. 2 2-72" mains

Fig. 5—Head-capacity curves of various combinations of pumping units superimposed on the low-service and high-service load curves of the high-lift plant. Water from the filtration plant may flow either directly to the suction channels of the pumps or over a weir to the clear-water reservoir, the latter also being connected to certain pumps. This allows a saving in pumping head where the reservoir level is below the weir. If only one discharge main is in existence when the demand on the high-service system exceeds 120 m.g.d., pressure must be reduced at control points.

specified, higher than the rated head, at which point the pump was to deliver "*not less* than" a specified quantity.

The bidders were required to submit an over-all, weighted efficiency guarantee, based on four different heads, weighted according to the importance of the several heads in the operation of the pump. It was in effect a guarantee over the operating range and reduced the possibility of a high but sharply peaked efficiency curve being selected in preference to one not quite so high at the rated point but flatter and better adapted over the entire range.

In comparing bids, "All bids that, in the opinion of the board, met the contract documents were compared by adding to the total sum bid $1,000 per per cent of over-all weighted efficiency that the bidder's guarantee is less than 80 per cent" for each 30-m.g.d. unit and $2,000 per per cent below 85 per cent in the case of each 60-m.g.d. unit.

Inasmuch as it was "not feasible to test the units in place over the entire range of head covered by the performance guarantees," the successful bidder was required to construct and test in his shop a 12-in. model and to establish by test thereof that the guarantees could be met before proceeding with the building of the full-sized pumps.

The pumps to be furnished were required to be "similar in all respects to their respective models having a constant ratio between all corresponding linear measurements and dimensions. No linear dimension in a pump furnished shall vary from the corresponding linear dimension of its model multiplied by the ratio of sizes more than 2 per cent."

With the above provisions there remained the contingency that the contractor might fail to establish by model tests his ability to meet his bid guarantees. The agreement therefore provided that in such an event "The board may reject the units and cancel the contract without obligation or the board may accept the said units and in the event it shall accept the said units, shall be compensated for such failure on the part of said contractor." The rates of compensation were made identical with the rates used in comparing bids, as given above—namely, $1,000 per per cent for each 30-m.g.d. unit and $2,000 per per cent for each 60-m.g.d. unit that the said unit "is to perform less than the guaranteed over-all weighted efficiency."

On the other hand a bonus for efficiency was offered "in the event the over-all weighted efficiency of the units deduced from the model tests are greater than the contractor's guarantee"; and the amount of the bonus was based on exactly the same rates per per cent of efficiency.

The final answer, however, as to the performance of the units was not to be based on the model tests but to be determined by field tests of the pumps "in their settings" in the low-lift plant. At least, according to the specifications, the board advised of its intention to conduct capacity and efficiency tests in the field at about the rated head and if, "under test in the field, the pumping units fail to perform in accordance with the results of the model tests" there is to be deducted for efficiency failure an amount based on the same rates as used in comparing bids and in figuring liquidated damages or bonus. In addition, there may be deducted also a liquidated damage for failure in capacity, determined as follows: "Five-hundred dollars per m.g.d. that the capacity of any unit is less by field test than that by deduction from the model test for rated speed and the particular head at which the field test is made."

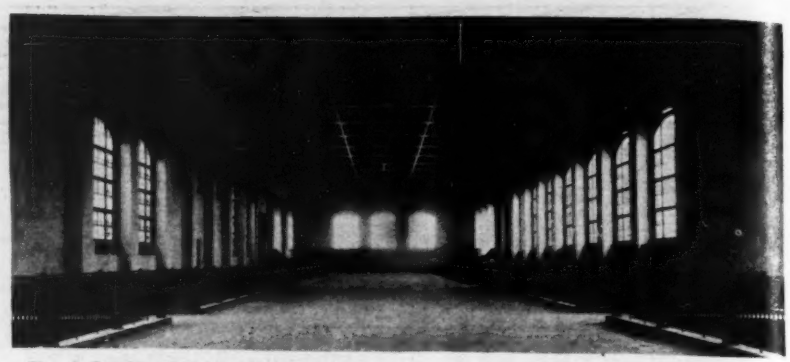


Fig. 6—Interior view of pumping station, showing pits for the high-lift pumps to the right and left of the central operating floor and the wall of the circular low-lift plant at the rear.

Other requirements of the specifications had to do with possible future changes in the impellers and the installation of air brakes. The specifications required that, in the case of all pumps rated at 50-ft. head, new impellers, to run at the original speeds, could later be installed with a rated head of 60 ft. and the original rated capacities. To meet the condition of added power required by the new impellers, the specifications required that the motors provided for the 50-ft. head pumps should be capable of carrying a continuous 20 per cent overload without exceeding a temperature rise of 50 deg. C. for the armature and the field.

Regarding air brakes, ordinarily the pumps are to be started and stopped behind closed valves in the discharges. Also every precaution was taken electrically to assure the quick closing of the valves in the event the pumps go off in an emergency. In the contingency of a sudden shutdown or power failure to the valves, however, a considerable volume of water in the discharge conduits would flow back through the pumps and tend to produce rotation in a reverse direction from normal operation. To meet such possible contingencies, the units are provided with air brakes. The brakes were required to have shoes working against the under side of the rotors, of ample size to stop and hold the rotors and to be entirely automatic. They are supplied with air at 60 lb. from pressure cylinders. In addition, the motors were required to be designed "so as to withstand safely the runaway speed of the pumps when running in the reverse direction."

The contingency of station flooding, although rather remote, was provided for by the installation of two dewatering and two sump pumps. About the only source of large leakage into the station would be from a broken pump casing or a break in one of the short lengths of cast-iron pipe in the suction and discharge connections; and if a casing should break, valves on both the suction and discharge, hydraulically operated and electrically controlled from the main floor, could be promptly closed. The dewatering pumps are provided with two-speed motors and are thus capable of operating at 55-ft. and 110-ft. heads. Under the lower head one of these pumps fits into regular operating service and provides an additional small unit to meet small changes in water demand; at the higher head the pump would be capable of dewatering the station and the supply tunnel. The piping and gate valves are so arranged that at any time one dewatering pump will always be ready for emergency service and the other for ordinary operation.

High-Lift Plant Units—A plan of the high-lift pumping plant is shown in Fig. 2 and a typical cross-section in Fig. 3. The superstructure which houses both the low- and high-lift plants is 108 ft. wide by 386 ft. long; the substructure of the high-lift plant proper is only about 270 ft. long. This plant will ultimately house sixteen pumping units; twelve units are now installed. The units are all of the motor-driven, centrifugal, horizontal-shaft type. They are located in groups of two, in pits 16 ft. below the finished grade; they take their suctions from sluice-gated chambers below the pits, and the chambers are supplied from central sluice-gated channels connected both directly to the filtration plant and to the clear-water reservoir, and they discharge into one or the other of two 72-in. mains in pipe vaults along either side of the plant. All of the units on the north side of the plant discharge into the high-service system, and

all on the south side into the low-service system. For the most part, the pumps on the east end of the plant receive their supply from the reservoir, and those on the west end from the filtration plant direct, although the gating arrangements will permit modifications in this respect.

Head and Load Conditions — The quantity requirements to be anticipated in the two pressure systems and a plan for distribution, involving the fixing of pressures (*ENR*, May 31, 1928, p. 855) afforded the basis upon which the pumps were purchased. The quantities to be delivered were estimated to be as shown below.

TABLE I—QUANTITY REQUIREMENTS FOR DETROIT'S TWO PRESSURE SYSTEMS

	Low-Service System			High-Service System		
	Minimum Hour, m.g.d.	Average Day, m.g.d.	Maximum Hour, m.g.d.	Minimum Hour, m.g.d.	Average Day, m.g.d.	Maximum Hour, m.g.d.
1931	39	70	130	28	51	94
1940	57	104	193	51	93	172
1950	76	137	254	38	69	128

The minimum-hour demand in the table was taken as about 55 per cent, and the maximum-hour demand at about 185 per cent of the average day demand. The lower values in 1950, as compared with 1940, assume the construction of the Northeast Station, which would take over a portion of the Springwells load.

The station pressures are expected to vary so as to maintain an approximately constant pressure at a control point, in each pressure system, substantially midway between the pumping plant and the extreme limits of the area to be served. The aim is to maintain at the control points, or in the central portion of each service area, not less than 50 lb., and at the outskirts, during hours of maximum consumption, not less than 25 lb.

In Fig. 5 are given the so-called "load curves" of the low and high services, respectively, which show the relationship between head and quantity of water to be pumped for the years 1931, 1940 and 1950. In both diagrams, two curves for each decade are shown, one marked "weir" and the other "reservoir." Water from the filtration plant may flow either directly to the suction channels of the pumps or over a weir to the clear-water reservoir, the latter being also directly connected to certain pumps as was noted above. The crest of this weir is somewhat below the level of full reservoir, so that with higher stages in the reservoir the weir is submerged; and water supplied to the pumps with a full reservoir is at about the same level whether coming directly from the filters or through the reservoir. But when, during hours of maximum demand, the reservoir level falls below the weir, the loss in head over the weir results in a corresponding increase in head on those pumps taking their supply from the reservoir. As the operating plan is to take a major portion of the total supply directly from the filters (and only the excess) needed to iron out hourly fluctuations in demand from the reservoir, this feature of design becomes a device to save head. Referring to the diagrams, it may be noted that the maximum difference in head as between the weir load curve and the reservoir load curve may amount to as much as 11 ft. Considering the relatively large quantities of water involved, this arrangement will result in an appreciable saving in power.

The range in operating heads in the two services (Fig. 5), is quite considerable. In the low service heads will vary, at the beginning, from 111 to 138 ft., but eventually from 115 to 175 ft., or an increase of high over low of about 50 per cent; in the high service the corresponding figures are: from 169 to 209 ft. at the beginning, and from 172 to 233 ft. ultimately.

Also, in Fig. 5, two plans are indicated: plan 1 is based on the losses to be anticipated with but one 72-in. main leading away from the pumps; plan 2 contemplates the possibility of two such mains at some future date. Under plan 1 the upper ends of the load curves fall off for quantities beyond 120 m.g.d., meaning that if only one main is in existence when the demand exceeds 120 m.g.d., it will be necessary to reduce pressures at the control points. This is a possible peak condition preceding the construction of the Northeast Station.

Fitting the Units—The methods used in selecting the units for the high-lift plant were identical with those employed for the low-lift, as above described. The characteristic head-capacity curves were determined by inspection, and the heads and sizes were so fixed as to: (*a*) operate with reasonable efficiency over the range of head; and (*b*) meet the maximum quantity requirements with a reasonable reserve. The pump characteristics shown in Figs. 4 and 5 are the guarantees of the pumps finally purchased and are as shown below.

No.	Capacity m.g.d.	Head, Ft.	Speed
LOW-SERVICE SYSTEM			
2	40	130	Variable
2	50	130	Constant
2	50	150	Constant
HIGH-SERVICE SYSTEM			
2	30	200	Variable
4	40	200	Constant

The difficulty of meeting maximum conditions when the operating head is high may be noted from the curves. For example, in the low-service system the installed pump capacity at rated head is 280 m.g.d., the maximum requirement in 1940 is 193 m.g.d., but the total available pump capacity is only 210 m.g.d. with the weir. While the excess, therefore, of installed capacity at rated head over the required capacity is 45 per cent the actual is only 9 per cent. By the installation of new runners the actual capacity may later be increased, however, to more than 240 m.g.d., using the "weir" load curve, or to about 25 per cent. Similarly, in the high-service system the ultimate maximum hour in 1950 was estimated to be 128 m.g.d., the installed capacity at rated head 220 m.g.d., but the actual capacity at the operating head only 140 m.g.d.

When the maximum-hour conditions are approached one of three courses may be pursued: a reduction of pressures at control points; additional distribution mains built; new pump impellers installed. In the high-service load curves shown a pressure reduction is anticipated by the dashed lines at the upper ends. The losses in mains are all based on the use of $C = 100$ in the Hazen-Williams formula. A somewhat larger value of C, which will no doubt be experienced, results in increased station capacity with any given pump installation. The actual station capacity will, therefore, prove to be larger than the curves shown would indicate.

Pump Specifications—The units for the high-lift plant were purchased under similar specifications to those above described covering the low-lift plant. Relatively steep head-capacity characteristics were required; in evaluating bids definite consideration was given to the over-all weighted efficiency guarantees; model tests over the entire operating range were specified to prove performance guarantees prior to the manufacturing of the pumps; and field tests were required, at about rated heads, to establish finally the bonus or liquidated damage as the case might be. Also, the bonus or damage computations were based on the same rates per per cent as were used in comparing bids.

Personnel — The plant described in this article was built for the Board of Water Commissioners of Detroit; it was designed and constructed under the supervision of the division of engineering of the department. The entire additional water-supply project was under the general direction of George H. Fenkell, chief engineer, assisted by Frank H. Stephenson, assistant chief engineer. The work described in this article was under the immediate direction of William C. Rudd, assistant engineer, assisted by Frank E. Simpson on structural design; Bernard J. Mullen, in charge of mechanical and hydraulic design; Carl J. Schoeninger, in charge of electrical design and construction. Laurence G. Lenhardt, assisted by Leo V. Garrity, was in charge of the building construction. The architect was John C. Thornton, of Detroit. The consultants on hydraulic problems and pump specifications were Ayres, Lewis, Norris and May, consulting engineers, of Ann Arbor, Mich. The preliminary engineering studies on types of pumping equipment were made by the Detroit Edison Co., under general direction of C. F. Hirshfeld, chief of research, assisted by Sabin Crocker and the staff of the engineering department.

Ten Business Problems of Contracting

VI—Appraisal of Equipment on Fixed Assets

Relationship of equipment investment to working capital—Causes of over-expansion of equipment investment—Renting equipment for peak volumes of work—Possibilities of substituting hand labor

By J. L. Harrison
Senior Highway Engineer, Bureau of Public Roads, Washington, D. C.

FROM the financial standpoint, the contractor's machinery and equipment are fixed assets. From the technical standpoint, they are the tools required in handling construction. Both of these aspects of equipment require consideration.

If a contractor is to have a sound financial structure, it is necessary that he have two things—ample working capital and an adequate investment in tools, machines and equipment. The term "adequate," as used here, means "sufficient" in the light of the kind of work to be undertaken and the volume of the work to be handled. Both kind and volume are important. The kind of work to be undertaken dictates the normal relationship between working capital and fixed assets, after which volume dictates the proper size of the investment under each of these two categories.

To illustrate, the proper ratio of working capital to fixed assets is different in office and apartment building construction than it is in concrete pavement construction. The amount of capital required in either field is then dependent on the volume of work to be handled and, of course, on the rate of turnover normal in the field. As a simple and rather a general rule, working capital should be moderately greater than the average monthly expenditure multiplied by the average time (in months) which elapses between expenditure and collection. Thus a contractor whose average expenditures are $50,000 a month and whose collections are made on an average of 60 days after the date on which his money is paid out will find that a working capital of something more than $100,000 is desirable.

Equipment and capital ratios

The fact that for every type of construction there is a normal relationship between fixed assets—that is, the investment in tools, machinery and equipment, for usually these are the principal items in the fixed-assets account—and working capital requires no comment. It will be perfectly clear to everyone who is familiar with construction work. But, though this fact is well recognized and the desirability of regulating the capital structure accordingly is obvious, the practice of so regulating it has not been widely followed.

The contractor's objective is profit; from the financial standpoint, a profit on the total capital that he has invested. Most of this capital is either free working capital or capital invested in tools and equipment.

But if this is the case, it follows quite naturally that as both are required in order to work at all, any distortion of the relationship between them tends either to leave a portion of the investment inactive or, if fixed assets are over-expanded, to force the contractor to borrow working capital, which always is expensive.

The general tendency in the contracting field has been to over-invest in equipment. The widely prevalent result has been to create large inventories of under-used or unused equipment and a shortage of working capital. From the financial standpoint this situation is disadvantageous in either or both of two ways. Unused equipment stands as an investment on which nothing is being earned. Under-used equipment is capital so invested that the earnings on it are below normal. In either case the investment is unprofitable.

This, of itself, is unfortunate, but as over-investment in fixed assets is quite generally accompanied by under-investment in working capital, to do business at all, working capital has to be borrowed either from banks or by purchasing materials on credit. In either case the charges are considerable. The net result is that when the investment is thrown out of balance by purchasing too much equipment a part of the capital earns little or nothing, because it is not used, while when margins of profit are low the charges generated by borrowing working capital tend to wipe out the profit which otherwise would be obtained on the capital that is used.

This would be serious enough, but in addition to the fact that idle equipment is idle capital, such capital as is invested in unused equipment has proved to be subject to rapid loss in value. Proper care, though a matter of considerable expense, tends to reduce the rate at which unused equipment depreciates, but during the past ten years or more improvements in construction equipment have been so rapid that in spite of good care, obsolescence has tended rather rapidly to destroy the value of unused equipment. The result has been that whenever the proper balance between working capital and the investment in fixed assets has been distorted by purchasing too much equipment, the capital so used has quite consistently proved a total loss.

In this connection it may be remarked that no such danger attends the over-expansion of working capital. True, if too much working capital is accumulated, the surplus over that which is actually needed has little or no earning power as long as it is retained as working capital. But the danger of losing it entirely is much less than in the case of over-investment in tools and equipment. On this account, if the capital structure is to be unbalanced, it is preferable to over-expand the working-capital account rather than the fixed-assets account.

Causes of over-investment

The tendency to over-expand the investment in tools and equipment is traceable to a number of causes. Of these the rapidity with which equipment has been improved and the sales pressure used in marketing equipment are among the more important. Every contractor naturally desires to have the best equipment that is available, for the cost at which work can be handled is affected by the quality of the equipment used. As might be expected, sales promotion takes full advantage of this fact. Nor is this to be criticized. The salesman presents the advantages that new equipment offers, for it is his business to stress the credit side of the proposed transaction. The debit side—the disadvantages of the transaction—must be worked out by the contractor.

Inevitably any study of these debits should include a careful appraisal of the effect of the transaction on the capital structure. This is not a simple matter, for while equipment is the major part of the contractor's investment in fixed assets, the value of this equipment is only relatively fixed, for as equipment is used it wears out with a corresponding loss of value. To be a profitable investment, equipment must, then, earn enough to cover this loss of value and to pay a return on the investment in it. But of more importance

here, as the value of this equipment decreases, whatever loss of value occurs should be set up in the accounts at regular intervals as a reserve for depreciation and thus established as a definite reduction in the value of the capital invested in equipment.

When the substitution of a new machine for an old machine, before the old machine has been worn out and so presumably eliminated from the capital account, is under consideration, the logical presumption is that improvements the new machine offers have rendered the old machine valueless except for any slight junk or trade-in value it may have. Therefore, if the capital account is to give a correct indication of the investment in equipment, the old equipment now having no value, whatever value still attaches to it in the records (less its junk value) should be at once charged off.

If this is regularly done, the contractor who has been too free a purchaser of new equipment will find that he quite often faces the very simple question, "But how am I to recover the $2,000 or the $5,000 which must be taken out of profit or out of working capital if I make this deal?" In some instances the manner in which the new equipment will enable the contractor to recover the loss of the old equipment will be clear enough. Where it is, the new equipment should be secured. But if the means of recovering any loss on old equipment is vague or doubtful, the wiser policy is to retain the old equipment until it is worn out or until the basis on which losses on it can be recovered is perfectly clear. In no event should a contractor who has purchased new equipment, to replace equipment partly worn out, retain the latter on his books at its then book value. If the equipment is valueless now, it will be valueless in the future. If it is not valueless now, it should be used until it has no further value, rather than be replaced. The depletion of so many working capital accounts is traceable to a very general failure to grasp this aspect of the replacement problem.

Another important cause of overinvestment in equipment is the tendency of contractors to take work in other than their normal fields of operation. That this should be done is not surprising. It does, however, present an equipment problem of some importance.

Normally, a contractor operates in a specific field. It is sound business policy to own whatever tools and equipment may be required in order to operate efficiently in this field. It is equally sound business policy to replace old equipment with new as often as may be required in order to keep at a minimum the cost of having this equipment and using it.

Within the field covered, the amount of equipment that it is desirable to own depends then on the volume of work which a contractor is organized to handle and the amount likely to be obtainable. In a previous article the fact that the volume of work which is offered varies widely from year to year has been noted. In good years this volume is much greater than in poor years.

Renting for peak demand

Admitting, then, that without question a contractor should own whatever equipment may be required in handling the type of work usually performed and the volume of this work ordinarily obtainable, there remains the question as to equipment for work taken in excess of the ordinary volume or outside of the usual field. The circumstances involved in taking an extra volume of work may not be the same as those involved in taking work in unusual fields. Indeed the first is apt to result from the fact that a large volume of work is being offered, while the second commonly results from a low volume of work in the field usually covered. Still, so far as the effect on the demand for additional equipment is concerned, the two are similar. They will, therefore, be discussed together.

The contractor's problem may be stated easily enough. If work is to be done, the equipment required in order to do it must be secured. Should this equipment, when required for an extra volume or an unusual type of work, be purchased or should it be rented? The answer is that usually it should be rented, but the reasons which govern the answer warrant consideration in some detail.

At any given time a contractor has a certain investment in tools and equipment and a certain investment in working capital. These, it will be assumed, are reasonably in harmony with the volume of business he is accustomed to handle. But, this being the case, if a larger volume of business is to be undertaken, additional capital must be secured in order to provide the additional working-capital handling which this business will require. Additional equipment will also be required, and if this is purchased, still more capital is involved. The charges on borrowed capital are so high that unless the general margin of profit at the time prevailing on construction work is unusually wide, they will absorb most if not all of the earnings normally to be expected on the working capital. If the equipment for work of this kind is purchased on a deferred-payment basis, the same is likely to be true here—that is, charges for the borrowed capital are likely to absorb the profit normally obtained on the fixed assets used in handling the work. In short, if business is expanded to a point where it is being altogether handled on borrowed capital, it is not likely to be profitable except in periods (see previous articles) when the general margin of profit is unusually high.

When the objective is business in a new line, the underlying reason is likely to be a lack of business in the line ordinarily covered. From the financial standpoint this suggests that the contractor has both working capital and equipment which are not fully employed. The working capital can be diverted to the new field. The equipment cannot. If the new equipment required in the new field is purchased on credit, financing charges are again likely to absorb the profits normally to be had from its use. Theoretically they should not absorb the profits to be expected from the use of the owned working capital, but they are quite likely to do so, for when work is scarce general margins of profit are low and charges for credit tend to rule high.

In neither case is the work taken likely, then, to prove very profitable. But this is not the worst aspect of the situation the contractor faces. The fact that ultimately the capital invested in unused equipment is likely to prove a total loss has been noted. Buying equipment to handle an unusual volume of business which will last for only a short period, and buying equipment to handle an occasional job outside of the field usually covered both tend to create inventories of equipment which cannot be kept busy and which, for that reason, generate large ultimate losses.

In view of these facts, which should be and probably are apparent to most contractors, the writer feels that it is much more logical from the business standpoint to rent the equipment that is required in order to handle either an unusual volume of business likely to last but a short time or the business occasionally obtained in other than the usual field. True enough, the rentals charged on contractors' equipment are apt to seem rather high. Still they are seldom much in excess of a fair charge for depreciation and a reasonable profit on the capital that is invested in this equipment. The contractor can, in short, rent equipment for the job at a price not in excess of what equipment purchased on credit will cost him during the same period. From the standpoint of probable profit on the work in hand, renting equipment then leaves him in about the same position he would occupy if he purchased the same equipment on credit. But from the long-term standpoint he is likely to be much better off if he rents, for in renting he makes no commitments which disturb other financial arrangements, he has no future bills to pay on account of this equipment and does not increase his investment in equipment that he cannot use.

Substituting hand labor

In this country the use of equipment in handling construction work is so general that contractors appear not to realize that pretty much all construction work can be done by hand-labor methods and that more often than might be supposed the normal advant-

tage that machine methods have over hand methods is rather narrow. This margin, of course, depends on a number of things of which the cost of labor, the cost of getting machines to and erected on the job, the cost of power and the cost of depreciation are among the more important. But because the normal advantage that machine methods have over hand methods often is rather narrow, when the amount of work to be done is small and when labor is cheap, it rather often happens that hand-labor methods are quite as cheap or cheaper than machine methods would be.

This matter is mentioned here only because of the bearing it has on the problems the contractor faces when he attempts to secure work in lines he is not equipped to handle. Renting equipment tends to give the owner of the equipment the profit normally to be expected on the equipment as a part of the capital used in handling such work. Buying it involves the additional risk that no more work can be obtained, with the result that the whole cost of this equipment will be lost. These results can often be quite largely avoided—particularly on small jobs—by resorting to hand-labor methods wherever the probable cost by hand labor is about the same as the probable cost by machine methods. It would be most unfortunate to assume that all of the risks which are involved in entering a new field can be avoided by a device as simple as this. Obviously they cannot. Still quite enough of them can be avoided to warrant more attention to hand-labor methods than these now generally receive.

Road-Tar Consistency Conversion Chart

Conversion curves determined by tests show relationship of road-tar consistencies as given by different methods

By E. O. Rhodes
Technical Director, Koppers Products Co., Pittsburgh, Pa.

CONSISTENCY, according to the American Society for Testing Materials, is "the degree of solidity or fluidity of bituminous materials." Consistency, as defined in this manner, is one of the important characteristics of a road tar, because this property, in part, governs the ease of application, the penetration into subgrade or road surface, the workability by drag, road-machine or mixer, the stability under traffic, the resistance to temperature changes, and other factors connected with the application or use of the road tar.

Unfortunately, there is no single consistency test that is suitable for all grades of road tar. Different methods of test or the same tests at different temperatures are or may be used for different consistency ranges. The more important instruments, tests and temperatures employed are as follows:

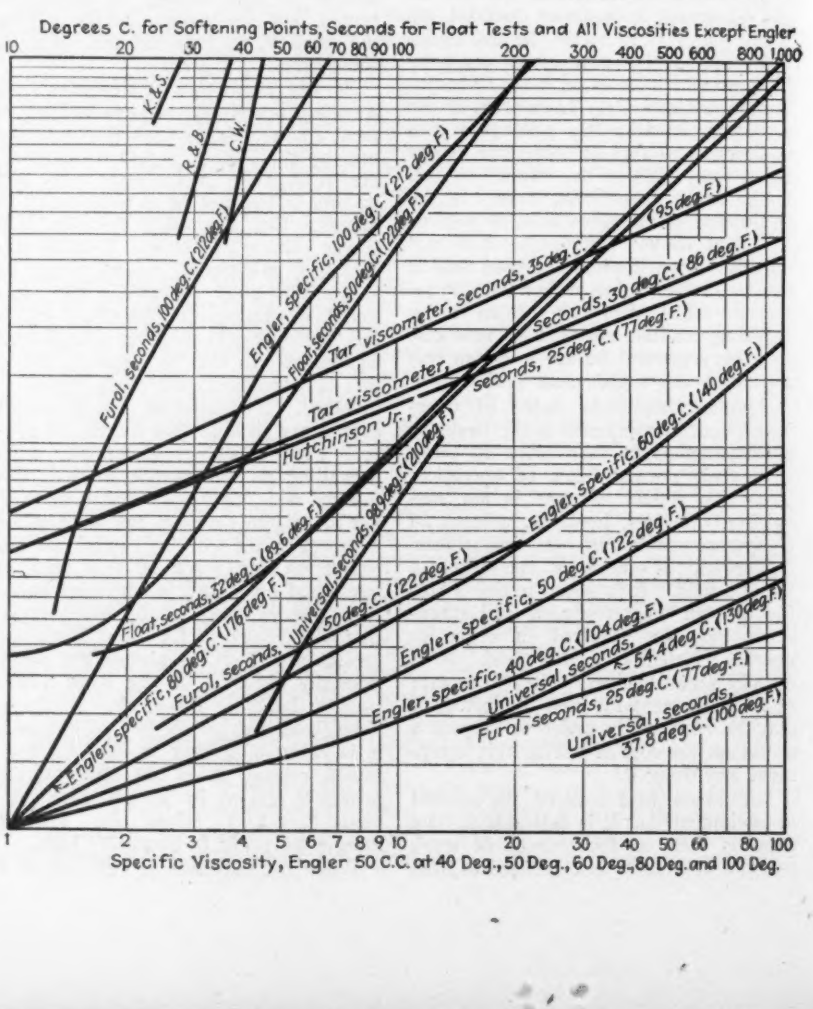
Engler viscosimeter, seconds or specific viscosity at 40, 50, 60, 80 or 100 deg. C.
Saybolt-Furol viscosimeter, seconds at 25, 50 or 100 deg. C.
Saybolt universal viscosimeter, seconds at 37.8, 54.4 or 98.9 deg. C.
Hutchinson's tar tester, seconds at 25 deg. C.
Tar viscometer (modified redwood viscometer), seconds at 30 or 35 deg. C.
Float tester, seconds at 32 or 50 deg. C.
Ring-and-ball softening point, deg. C. and F.
Cube-in-water softening point, deg. C. or F.
Kraemer and Sarnow softening point, deg. C. or F.

Conversion curves

Frequently it is necessary or desirable to interpret the result of one consistency test in terms of another. In such cases actual determinations must be made, or conversion curves that represent average consistency relationships must be employed for tests that are being compared. No one set of conversion curves will represent the consistency relationships for different types or classes of road tars. Consistency relationships are not exactly the same for road tars derived from horizontal retort tar, from byproduct coke-oven tar or from water-gas tar. Even road tars from one variety of coal tar, such as coke-oven tar, differ slightly in their consistency relationships. Obviously consistency conversion curves cannot be expected to replace actual determinations when accuracy is required, but frequently they are useful when approximations are sufficient.

The technical department of the Koppers Products Co. has prepared the accompanying set of conversion curves for its various grades of tar. It should be of use to other companies or individuals who wish to convert con-

Chart for computing consistency relationships for road tars from one typical coke-oven tar.


Degrees C. for Softening Points, Seconds for Float Tests and All Viscosities Except Engler
10 20 30 40 50 60 70 80 90 100 200 300 400 500 600 800 1,000
K. & S.
R. & B.
C. W.
Furol, seconds, 100 deg. C. (212 deg. F.)
Engler, specific, 100 deg. C. (212 deg. F.)
Float, seconds, 50 deg. C. (122 deg. F.)
Tar viscometer, seconds, 35 deg. C. (95 deg. F.)
Tar viscometer, Seconds, 30 deg. C. (86 deg. F.)
Tar viscometer, seconds, 25 deg. C. (77 deg. F.)
Hutchinson Jr., (210 deg. F.)
Float, seconds, 32 deg. C. (89.6 deg. F.)
Furol, seconds, 80 deg. C. (176 deg. F.)
Engler, specific, 80 deg. C. (176 deg. F.)
Universal, seconds, 98.9 deg. C. (210 deg. F.)
50 deg. C. (122 deg. F.)
Engler, specific, 60 deg. C. (140 deg. F.)
Engler, specific, 50 deg. C. (122 deg. F.)
Engler, specific, 40 deg. C. (104 deg. F.)
Universal, seconds, 54.4 deg. C. (130 deg. F.)
Furol, seconds, 25 deg. C. (77 deg. F.)
Universal, seconds, 37.8 deg. C. (100 deg. F.)
1 2 3 4 5 6 7 8 9 10 20 30 40 50 60 80 100
Specific Viscosity, Engler 50 C.C. at 40 Deg., 50 Deg., 60 Deg., 80 Deg. and 100 Deg.

sistencies by one method into consistencies by other methods for road tars made principally or entirely from by-product coke-oven coal-tar.

The samples that were tested to obtain the data for these consistency curves were all prepared in accordance with commercial procedures from base materials made from one typical and average byproduct coke-oven coal-tar. For this reason the curves may be considered as representing average conversion relationships for road tars made entirely or principally from normal by-product coke-oven tars. However, they should not be used for road tars made principally or entirely from horizontal-retort tar or water-gas tar.

In preparing these conversion curves all consistencies were referred to Engler specific viscosities for 50 c.c. at 80 deg. C. For this reason the curve for that particular test is a straight line connecting the lower left-hand and the upper right-hand corners of the diagram. The numerals across the top of the diagram represent degrees C. for the Kraemer and Sarnow, ring-and-ball and cube-in-water softening points. The same numerals represent seconds for float tests at 32 and 50 deg. C., Saybolt-Furol viscosities at 25, 50 and 100 deg. C.; tar viscometer (modified Redwood) viscosities at 30 and 35 deg. C.; Hutchinson (junior model) consistencies at 25 deg. and Saybolt-Universal viscosities at 37.8, 54.4 and 98.9 deg. C.

The numerals at the bottom of the diagram represent Engler specific viscosities for 50 c.c. at 40, 50, 60, 80 and 100 deg. C.

Conversion procedure

In order to convert from one test to another, it is necessary only to follow a horizontal line from the curve representing the first test to the curve for the second test and then read the numeral at the top of the diagram if softening point, float test, Hutchinson consistency or viscosity Saybolt-Furol, Saybolt-Universal or tar viscometer is involved, and at the bottom of the diagram for Engler specific viscosities.

The following example will illustrate the manner in which the curves may be used. Starting with a tar having a ring-and-ball softening point of 30 deg. C., locate the point on the ring-and-ball softening-point curve directly below the numeral 30 at the top of the diagram. Follow the horizontal line that intersects the ring-and-ball curve at this point, and the following conversions may be noted:

Cube-in-water softening point	39 deg. C.
Saybolt-Furol viscosity at 100 deg. C.	42 sec.
Engler specific viscosity, 50 c.c. at 100 deg. C.	11 deg.—Engler
Float test at 50 deg. C.	130 sec.
Engler specific viscosity, 50 cc. at 80 deg. C.	46 deg.—Engler
Float test at 32 deg. C.	500 sec.
Tar viscometer, viscosity at 35 deg. C.	760 sec.

DESIGNATIONS OF TESTS AND REFERENCES

K. and S. (Kraemer and Sarnow) softening point—Abraham's "Asphalts and Allied Substances," 3d Edition, p. 682.
R. and B. (ring-and-ball) softening point—American Society for Testing Materials, serial designation D 36-26.
C. W. (cube-in-water) softening point—American Society for Testing Materials, serial designation D 61-24.
Furol (Saybolt-Furol) viscosity—American Society for Testing Materials, serial designation D 88-30.
Universal (Saybolt-Universal) viscosity—American Society for Testing Materials, serial designations D 88-30.
Engler, specific viscosity—United States Department of Agriculture—Bulletin 1216, p. 85.
Float test, seconds—American Society for Testing Materials—serial designation D 139-27.
Tar viscometer (modified Redwood) viscosity—"Standard Methods for Testing Tar and Its Products," British, 1929, p. 63.
Hutchinson's tar tester, junior model, British standard specification for tars for road purposes, No. 76, 1930, p. 17.

Each of the tests used in preparing these conversion curves was performed in strict accordance with the directions given by the recognized authority, cited in the "Designations of Tests and References" tabulated above.

The preparation of these curves afforded an opportunity to study the accuracy obtainable by each method of test and to determine which method is best suited to road tars in each range of consistency. In general, it was found that for the lower ranges of consistency Engler specific viscosities at 40 and 50 deg. C. are most satisfactory. For higher ranges of consistency float tests at 32 and 50 deg. C. are preferred. In other words, all present grades of road tar can be tested satisfactorily with these two consistency determinations—namely, by the float test and by Engler specific viscosity.

Development Council Begins Unification of Profession

New intersociety body aims to bring together college, engineering society and licensing board for joint action to improve the status and efficiency of the profession—Four major problems are under study

AT A MEETING in New York on Oct. 10 the Engineers Council for Professional Development reached permanent status as the joint representative of seven technical societies, by the election of C. F. Hirshfeld as chairman and C. E. Davies as secretary. Both Mr. Hirshfeld and Mr. Davies have been acting temporarily since the organization meeting in October, 1932. As expressed in its charter, the purpose of the Council is "to enhance the professional status of the engineer by coordinating and promoting efforts and aspirations directed toward higher professional standards of education and practice, greater solidarity of the profession, and greater effectiveness in dealing with technical, social and economic problems."

In keeping with this purpose the meeting received and discussed reports of four committees that had been at work during some months on the four major items of the Council's program, following the temporary organization of the Council a year ago. Since that time the charter and rules of procedure of the Council have been approved by the participating societies, which include the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers, the Society for the Promotion of Engineering Education, the American Institute of Chemical Engineers, and the National Council of State Boards of Engineering Examiners.

The formation of the E.C.P.D. grew out of a Conference on Certification, formed nearly two years ago by the seven societies mentioned. That conference, in turn, was brought about by dissatisfaction with differences in qualification for membership in the major technical societies, the relation of the societies to the activities of state licensing boards as well as to technical college curricula and degrees, and a conviction that the efforts of these several agencies ought to be harmonized in the interests of clarifying the organization and raising the level of performance of the engineering profession.

A specific program for the work of the E.C.P.D. is laid down in its charter, comprising four points:

(1) To develop further means for the educational and vocational orientation of young men with respect to the responsibilities and opportunities of engineers, in order that only those may seek entrance to the profession who have the high quality, aptitude and capacity which are required of its members;

(2) To formulate criteria for colleges

of engineering which will insure to their graduates a sound educational foundation for the practice of engineering;

(3) To develop plans for the further personal and professional development of young engineering graduates, and also of those without formal scholastic training;

(4) To develop methods whereby those engineers who have met suitable standards may receive corresponding professional recognition.

To develop studies and recommendations covering the four points of this program, representative committees were appointed last October, upon the temporary organization of the Council, as follows. Student selection and guidance (chairman, Dean R. L. Sackett, Pennsylvania State College), engineering schools (chairman, President Karl T. Compton, Massachusetts Institute of Technology), professional training (chairman, R. I. Rees, American Telephone & Telegraph Co.), and professional recognition (chairman, Conrad N. Lauer, Philadelphia Gas Co.). The progress reports of these committees as presented at last week's meeting and as discussed and revised by the Council, have the major features noted below.

Student selection and guidance

The purpose of this committee is not recruiting or increase of the number of entering engineering students. It has determined, however, as its first objective to (a) recommend sources of information for interested student candidates on engineering education and the engineering career, and (b) prepare such information if satisfactory occupational literature is not available.

A subcommittee, after studying and considering such literature pointed out that it is desirable to discover "the engineering type of mind," stating the specific engineering qualities rather than the general qualities of character required in all professions, and including physical as well as mental aptitude. Through other subcommittees, the committee has undertaken to investigate experience with occupational guidance, the possibilities of the summer camp system (presumably directed to vocational guidance in engineering), experience with aptitude tests and related problems. Cooperation with high school teachers and with the Boy Scout organization as well as with local engineering societies is also in contemplation.

Engineering schools

Examining the problems of accrediting approved engineering schools is the committee's objective. From study of the subject it reached the conclusion that regardless of theoretical desirability or the opposite, accrediting of engineering schools is being carried out by various uncoordinated agencies, not in a representative and authoritative manner, and should be carried out by the E.C.P.D. It therefore recommended to the Council that a program of accrediting be undertaken by the Council, on the basis of general principles which it outlined. The committee does not believe that it is desirable to make any specification of the number of hours and credits required in order that a curriculum may be approved, or that there should be published prescriptions regarding curricula. The formation of seven regional committees on engineering schools is proposed for the purpose of making the necessary local studies and visits required to guide the Council in accrediting the different institutions.

Professional training

In a small sampling canvass of the attitude and study habits of a group of junior members of technical societies, the committee on professional training found that some young engineers could be greatly benefited by assistance in planning their development in logical sequence. It is developing a self-analysis blank for assistance in enabling anyone to make a program for future development. It is also surveying the available educational facilities, is planning to prepare reading lists for the non-technical or broadening continuation education of young engineers, and has begun study looking toward the participation of local sections and societies in the educational work.

No recommendations were made.

Professional recognition

The committee on professional recognition directed its efforts toward establishing as the goal of the engineer's attainment a series of qualifications for which the young member or candidate may strive continuously from the time he enters upon an engineering career, the goal of attainment to be represented by a certificate equivalent to a professional degree and adequate to entitle the holder to licensing. At each step the accomplishment of the desired attainment is to be tested by examination, rather than by personal estimate and testimonial; the qualifications should cover economic and civic as well as technical and scientific knowledge. The committee further proposed that colleges should support this certification movement by granting the professional degree to those who have been certified, while licensing boards should "with confidence recognize those essentials which they observe as requisites for the registration of engineers."

As specific expression of minimum qualifications for an engineer the committee proposed four years of successful college work supplemented by four years or more of active practice of satisfactory kind, to be followed by examination; or eight years or more of active practice supplemented by an examination covering both this period of practice and the field of normal college courses.

The professional recognition is to be expressed, according to the committee's recommendation, by three society membership grades: student member (engaged in study), junior member (graduate or equivalent), and member (one who has satisfied the minimum requirements previously stated). A fourth grade of membership, designated as Fellow, was proposed by the committee to serve as a means of recognizing "the more mature engineer," but the Council did not concur.

The committee is proceeding to consider examinations and other procedures for measuring the attainment of the standard indicated. It recommended that engineering schools be asked to cooperate in limiting professional degrees to those who have attained the minimum standard.

Aims and objectives discussed

At a dinner of Council members and friends held after the meeting, some of the objectives and problems of the new movement were further discussed.

Chairman Hirshfeld, in an opening address, expressed the reason for the formation of the Council by saying that the world insists on the engineer's occupying a professional status, and that professional men believe that they can fix this status better than the civil world. It is for this reason that the Council has undertaken to improve its processes of selection, education, postgraduate guidance and, finally, recognition of accomplishment. This movement, however, said Mr. Hirshfeld, wil succeed only if the great majority of engineers perceive the necessity and desirability of the task undertaken.

Dr. Franklin Keller, director of the National Occupational Conference, spoke of the general problem of occupational guidance. One of the requisites, as he pointed out, is clear definition of the essential determinant of an occupation, and he asked whether "the pattern of the engineer" has yet been described. He also indicated that for sound occupational guidance it is necessary to be able to foresee which occupations will grow and which will die off.

Dean Dexter S. Kimball, of Cornell, expressed doubt whether there is a pattern of the engineer. The primary requisite for success in engineering is to know something about engineering. Beyond this fundamental point, he suggested there is probably no pattern of the engineer.

Dr. D. B. Steinman expressed the E.C.P.D. movement as aiming at the ideal of defining an integrated, unified profession, and marking it off clearly from other human pursuits. This, with the associated ideal of raising the quality of engineering membership and performance, is being attacked by the Council through the same methods applicable to the improvement of a mechanical product: better selection of material, improved and supervised production, refining treatment after production, and, finally, acceptance by test.

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

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An Expanded Textbook on Hydraulics

Reviewed by Robert E. Horton
Consulting Hydraulic Engineer, Voorheesville, N. Y.

HYDRAULICS—By Horace W. King and Chester O. Wisler. Third edition, revised Cloth; 6x9 in. pp. 292; tables and diagrams. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., London. $2.75.

THE third edition of this book contains 292 as compared with 237 pages in the first edition, published in 1922. In general, the book is characterized by clear and abundant diagrams and clearness and simplicity of style. There are perhaps as few errors as is possible in view of the necessity of brief treatment in a textbook, and also in view of the present rapid advance of knowledge of hydraulics. The difficulty of avoiding errors where, as is necessary in a textbook, qualifying statements are undesirable, is illustrated by the statement appearing on p, 103, that for an orifice with three contractions suppressed, the discharge coefficient is about 0.69. This statement is only true, as has been shown by recent experimental data, in case the jet is unsupported downstream from the orifice. If the jet is supported adjacent to the elements of the periphery where the contraction is suppressed, then the discharge coefficient drops back to 0.611 as for a fully contracted orifice, and this holds true whether contraction is suppressed on one, two or three elements of the perimeter.

As stated in the preface to the third edition, new features of the book are: (1) the inclusion of factors for viscosity and density in fundamental discussion and formulas, thus making them applicable to other liquids than water; (2) an increase of 60 per cent in the number of problems; (3) a new chapter on nonuniform flow, with some discussion of a particular case of variable flow. The particular case is that of a single-faced wave that occurs when a transition takes place from one regimen of steady flow to another. The discussion of wave motion is based primarily on momentum control, disregarding friction, and its applicability is accordingly limited.

The book reflects not only the senior author's long practical experience in design, construction and operation of hydraulic works, but it also reflects the experience of both authors in teaching. The problems follow somewhat the excellent English practice of elucidating—using illustrations where necessary—kinks and perplexing points passed over in the text.

There has been too much teaching of mechanics and mathematics, particularly the subject of hydraulics and calculus, along the lines of least resistance. There may be arguments in favor of keeping the student's attention confined to established principles, but a newly graduated student who has not yet acquired a sense of proportion by experience may go wrong, not because of lack of knowledge of principles but through lack of knowledge of their limitations. Problems such as those presented in this book serve as sign posts to direct the uninitiated wayfarer at points where he must leave the beaten paths of established principle and make his way as best he can, with little to guide him beyond his individual resourcefulness.

Fresh-Water Algae

Reviewed by Gordon M. Fair
Associate Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

THE FRESH-WATER ALGAE OF THE UNITED STATES—By Gilbert M. Smith. Cloth; 6x9 in.; pp.716; diagrams. Published by McGraw-Hill Book Co., Inc. New York and London. $6.

AS POINTED OUT by the author, this book has been written with a twofold purpose: "To enable the student to identify the fresh-water algae of this country; and to summarize the morphology of life histories of these algae." This purpose has been fully accomplished, and all genera of algae found in the United States are described in detail. One or more species of each genus is illustrated in simple but adequate line drawings. Since the algae found in the brackish waters of estuaries and tidal marshes are essentially marine, they have been excluded from consideration. The algae of the inland brine lakes, however, are included.

Discussion of the nature, evolution and classification of the algae, their occurrence and distribution, their collection and preservation and methods for their study serves as an introduction. There follow chapters on the myxophyceae (blue-green algae), rhodophyceae (red algae), heterokontae (yellow-green algae), crysophyceae (including a number of chlorophyllaceous protozoa), bacillarieae (diatoms), chlorophyceae (green algae), dinophyceae (dinoflagellates), and euglenophyceae (green flagellates). Each chapter is prefaced by a discussion of the nature, occurrence, organization, reproduction, relationships and classification of the organisms treated. The text closes with a comprehensive key utilizing so far as possible vegetative rather than reproductive characters for recognition of the genus. An extensive bibliography and index are included.

Not since Wolle wrote his monumental treatise in 1887 has an attempt been made to include under single authorship all fresh-water algae in the United States. Wolle's work did not cover more than a quarter of the genera now known to occur in this country. The magnitude of the task accomplished by Professor Smith is therefore evident. Engineers will find in this book the answers they may seek to the identification and life history of algae whose occurrence is significant in engineering structures: water supplies, water conduits and controlled lakes and streams.

Miscellaneous Notes on Booklets and Reprints

A BIBLIOGRAPHY OF TIME STUDY ENGINEERING has been compiled by the Buffalo Chapter, the Society of Industrial Engineers, Buffalo, N. Y. The bibliography includes motion study, wage incentives and fatigue in industry.

REINFORCED-CONCRETE CONSTRUCTION, as practiced in India, is illustrated in a booklet of about 90 pages describing various reinforced-concrete bridges and buildings that have been built by the construction department of Bird & Co., Calcutta, India.

INDUSTRIAL RESEARCH LABORATORIES of the United States, together with their research staffs and the subjects of research work, are listed in Bulletin No. 91 of the National Research Council, National Academy of Sciences, Washington, D. C. Price, $2.

DETERMINATION OF STRESSES from strains on three intersecting gage lines and their application to actual tests is the subject of Research Paper No. 559, U. S. Bureau of Standards. Copies may be obtained from the Superintendent of Documents, Washington, D. C. Price, 5 cents.

PAPERS PRESENTED AT THE 19TH ANNUAL ROAD SCHOOL, held at Purdue University in January, 1933, are contained in Engineering Bulletin, Series No. 30, Engineering Extension Department of the university at Lafayette, Ind. Copies are free to residents of Indiana; 25 cents to others.

MODERN TRENDS IN RAILWAY MOTIVE POWER, an address by William C. Dickerman, president, American Locomotive Co., before the New York Railroad

Club in April, 1933, has been reprinted by the American Locomotive Co. Copies may be obtained from the company, 30 Church St., New York City.

HIGH SILICA CEMENT and its several special advantages, particularly in the presence of sea water and alkali and in massive structures, is the subject of a pamphlet issued by the Santa Cruz Portland Cement Co., Crocker Building, San Francisco. This company's high silica cement is a combination of portland and puzzolana cements formed by intergrinding of the two materials.

ROAD CONSTRUCTION COSTS have not outstripped population growth, rateables and general development, according to the final report on the county highway plan for Morris County, New Jersey, prepared by the National County Roads Planning Commission, Washington, D. C. Past expenditures for road purposes are analyzed, and a program of construction for the next twelve years is outlined.

CONCRETE IN SULPHATE WATERS is discussed in Technical Bulletin No. 358 of the U. S. Department of Agriculture, a report of laboratory and field tests of concrete exposed to the action of sulphate waters, written by Dalton G. Miller, senior drainage engineer of the department, and Philip W. Manson, of the University of Minnesota. The report covers a study of failures of concrete pipes in 23 counties in Minnesota and 4 counties in northern Iowa, and laboratory studies carried on at the University of Minnesota. It is intended to furnish engineers, manufacturers and pipe users with information that will more nearly make it possible to eliminate failures of agricultural drain tile. The bulletin is for sale by the Superintendent of Documents, Washington, D. C., for 10 cents.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ANTRIEBSVERHÄLTNISSE UND KRAFTESDIEL AN BACKEN-STEINBRECHERN, INSBESONDERE AN GROSSBRECHERN—Section 5. By Dr. Alfred Bonwetsch. Paper; 8x12 in.; pp. 63; line drawings and tables. Published by VDI-VERLAG, Berlin, Germany.

HANDBUCH FÜR EISENBETONBAU—Behälter, Maste, Schornsteine, Rohrleitungen. Sections 2, 3 and 4; Fourth edition. Paper; 7x11 in.; pp. 160; diagrams, tables and halftones. Published by Wilhelm Ernst & Sohn, Berlin, Germany. 5.50 RM each.

SAFETY AND ECONOMY IN HEAVY CONSTRUCTION—By Ray J. Reigeluth. Fabrikoid; 5x8 in.; pp. 237; photographs, tables and line drawings. Published by McGraw-Hill Book Co. Inc., New York and London. $2.50.

VALUABLE HINTS TO INVENTORS—By A. F. Gillet. Cloth; 5x8 in.; pp. 94. Published by The Inventors Publishing Co., Washington, D. C. $1.

Planned Road Systems Urged by Highway Officials

Annual meeting of A.A.S.H.O. stresses a return to normal financing following emergency program, and rational planning of public roads systems as continuing transportation agencies

PROGRESS of the emergency highway program; return to the regular federal-aid plan, requiring states to match federal funds; limitation of state road taxes to road purposes; and development of system consciousness in programing road improvement were leading subjects considered at the nineteenth annual meeting of the American Association of State Highway Officials held at Milwaukee last week. Nearly 300 road officials from 44 states were in attendance, and all sessions were full. Technical committee work was advanced in a dozen or more full-day group meetings, in which suggestions, criticisms and plans were presented to the working committees in round-table discussion.

Progress in prosecuting emergency programs, as brought out by surveys made by the district vice-presidents of the association, will be summarized separately in next week's issue. In the general meeting program the report of the executive secretary and papers by Thomas H. MacDonald, chief, Bureau of Public Roads; Frank T. Sheets, formerly state highway engineer of Illinois, and E. W. James, chief, division of highway transportation, Bureau of Public Roads, were of outstanding interest.

Statistical review

Interest in the statistical review by W. C. Markham, executive secretary, centered particularly in the figures for highway employment, for transfers and diversions of highway funds, and for amount of highway funds to be available for work in 1933 and 1934.

In July of this year 331,787 persons were employed directly on state and federal roads. At that time none of the emergency funds of $400,000,000 was under contract. The average of highway employment was one person for every 399 of population. It was emphasized that the total of 331,787 included only direct labor and excluded prisoners worked and all employment on roads by counties, townships and towns and cities. Assuming the conservative ratio of two persons employed directly, the total highway employment for July was about 1,000,000.

Diverted road taxes

Legislatures in 1933 were liberal in transferring state road-tax funds to counties and municipalities and in diverting such funds to state uses for other than highway purposes. The figures for the United States were as follows:

Transfers to counties and townships	$90,459,48
Transfers to cities	24,952,56
Transfers to purposes other than highways	91,118,68
Total	$206,530,73

After these deductions the estimated probable state funds for highway purposes total $485,725,931 for 1933 and $448,704,238 for 1934. These are decreases from 1932 of $275,725,000 and $312,750,000 respectively.

As a further picture of the present financial background of state programs, the following is the statement given of funds from every source:

	State plus half PWA fund	Total for Year	Decrease from 1932	Per Cent Federal
1933—	$721,416,282		$175,000,000	32
1934—	644,446,881		253,850,000	30

The report closed with the statement that, since the secretary's report of a year ago, heads of highway departments had been changed in 26 states.

The PWA road program

Stressing the need for activity in getting PWA funds at work in relief of unemployment, Thomas H. MacDonald in a vigorous address stated that "Our recovery program must plan highways to meet both metropolitan and rural needs . . . . and launch an effort to eliminate hazards of all kinds to highway safety." Some sacrifice of efficiency is warranted to get men promptly to work and to give employment this winter. Summing up the status of the highway recovery program at the moment, Mr. MacDonald said: "Projects estimated to cost $95,000,000 are already under contract. Additional projects estimated to cost $45,000,000 are approved and ready for contract. Work is actually under way in 44 states and the District of Columbia. The rate of preparation, submission and approval of completed plans for new projects has now reached 1,100 per month. This means that upward of 4,000 projects will be prepared and approved and a large percentage of them under construction by Dec. 1."

In round figures the PWA program includes 6,000 projects. Thus two-thirds of the work contemplated will be under contract by the new year.

Economic surveys

Highway planning was discussed by Frank T. Sheets in an elaborate paper.

He laid stress on the need for sound programing of basic data developed by traffic and economic surveys. Referring to the economic surveys made in a few states by the Bureau of Public Roads, Mr. Sheets said:

An invaluable tool for the planner of highway programs is the economic survey. Such a survey should reveal the sources and distribution of highway revenues, general revenues, etc. In completed form it should answer these questions:

1. In what proportion are highway revenues collected from residents of the following places?
   (*a*) Rural areas
   (*b*) Municipalities having
      1. Population of 0- 2,500
      2. Population of 2,500- 15,000
      3. Population of 15,000- 75,000
      4. Population of 75,000-400,000
2. In what proportions are highway revenues expended for work in these places?
3. In consideration of the foregoing data and the data revealed by traffic surveys regarding the use of the various thoroughfares by various citizens, what distribution of these revenues will be just, economically sound and for the greatest public good?

Describing the recent rational planning of a highway program for Illinois (*ENR*, Feb. 23, 1933, p. 256), Mr. Sheets concluded:

The benefits of rational planning are many. Public confidence in the state government, praise for the state highway department, closer cooperation between state, city, county and other local officials, popular approval of highway programs, cheerful payment of highway taxes for demonstrated needs and protection of special highway funds will inevitably follow.

Today's chaotic conditions are a challenge. The highway case can and must be proved. Only in this way can the public's best interests be served. Never before in highway history have the needs for intelligent leadership been more pressing, the opportunity for public service greater, nor the potential benefits of rational and diversified highway development more attractive.

Association business

The association business affairs were reported to be in order, with finances in good condition. Publication and other activities are proceeding normally. O. S. Warden, chairman, Montana Highway Commission, was elected president of the association for 1934.

Letters to the Editor

Not a Rock-Fill Dam

Sir—I was interested in reading the discussions on the failure of the Castlewood Dam near Denver, appearing in your journal Aug. 10 and Sept. 7. I have also read the discussions on the construction of the original project in *Engineering Record* of Dec. 24, 1898, and *Engineering News* of Feb. 9, 1899. From those descriptions, it has been a misnomer to call this structure a rock-fill dam, as the central portion behind the 4 ft. of masonry face consists of loose dumped stone with muck; so that, under no circumstance, should rock-fill dams as a type be blamed for this failure.

The original promoters had not only local inexperienced engineers but financial difficulties in building it, and some engineer doctors were called in from New York including the late Mr. Boller, by people who advanced the capital, to pass on its construction. Besides the fundamental difficulties of having mud in the body of the dam, it was also afflicted with an inadequate spillway only 5 ft. in depth for a width of 40 ft. The state engineer of Colorado, who had jurisdiction over this dam for ten years, should have had the judgment to have this spillway enlarged. Penalty for the failure is, however, directly placed on the backs of the unfortunate inhabitants who lived below the dam. The obligation for the engineering blunder rests on the engineering profession who permitted this inadequate structure to stand without challenge for 40 years. There are 165 square miles above the dam, and 100 sec.-ft. per square mile should make a possible flood of 16,500 sec.-ft. According to John A. Field, the actual spillway capacity was only 3,000 sec.-ft., or one-eighth of the requisite amount.

I am writing this letter for the purpose of removing the false implication that the dam failed because it was of the rock-fill type, for it was not.

M. M. O'Shaughnessy,
Consulting Engineer,
Public Utilities Commission,
City and County of San Francisco.
San Francisco, Calif.
Sept. 15, 1933.

Aggregate Interlock at Pavement Cracks

Sir—A. C. Benkelman's article in your issue of Aug. 24, 1933, p. 227, reporting tests of aggregate interlock in cracks and dummy joints of concrete pavement slabs, presents test data which is both interesting and valuable. So likewise is the evidence which shows that reinforcement, in minimizing the width or opening of cracks, aids effectively in the transference of shear across the crack. I believe, however, that Mr. Benkelman's conclusions, unfavorable to the use of transverse dummy joints, are much too broad and should be restricted to at least the conditions obtaining in his tests: namely, a transverse crack or joint spacing of 50 ft. Furthermore, attention should be directed to the fact that all which has been presented is evidence showing a greater shear transference with one construction than with the other; there is no evidence submitted to show that the lesser shear transference is insufficient or inadequate for the needs.

To justify the recommended use of 6 lb. of reinforcement per square yard at an increase in paving cost of 15 to 20c. per square yard would seemingly require additional evidence showing that the joints and cracks where the reinforcement was absent were weak and progressively broke down and failed. It is not the writer's observation that this is the case.

Mr. Benkelman's tests appear to have been confined to slabs 100 ft. long with a single transverse crack at about the middle. As he anticipated and found, however, in other slabs having more numerous cracks, the width of the cracks decreased as their number increased, and it is approximately correct to say that the width of the cracks in a given distance—e.g., 100 ft.—will be inversely proportional to the total number of cracks.

Therefore, by the use of transverse dummy joints spaced 20 ft. on centers the width of Mr. Benkelman's crack would be reduced 75 per cent; should the spacing be made 15 ft., the reduction would be 85 per cent. With such reductions effected, the shear transfer value would be increased very substantially.

If anyone should feel that the above assumption regarding crack widths departs too widely from those which Mr. Benkelman measured at the edges of certain slabs, it is to be noted that the widths of the cracks in the companion reinforced slabs that he measured were found to be eight to ten times greater than those of the cracks in the reinforced slabs that were subjected to the loading tests.

Under these conditions neither sweeping conclusions nor precise percentages appear to be warranted. Here, as elsewhere, the findings and conclusions of research need to be checked against reality; if a lack of concordance is found, then there is need for a revision of the conclusions. It is a fact of reality that edge weaknesses at transverse dummy joints have never developed and are practically non-existent in all the hundreds of miles of pavement in which they have been used, while corner breaks with dummy joints occur but rarely.

It is hoped that in thus differing with Mr. Benkelman's conclusions nothing has been said that will be interpreted as in any way detracting from the credit due him for performing a much-needed piece of work in a thorough and satisfying manner.

H. F. Faulkner,
Junior Engineer,
City Engineering Department.
Seattle, Wash.,
Sept. 14, 1933.

Engineering News-Record

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Master of Human Arts

A DEEP SENSE of personal loss will remain with many throughout the country because of the passing of J. Waldo Smith, builder of the Catskill Aqueduct. Back of this sentiment lies a story of the power of the spirit to influence engineering achievement, a dramatic story that had its beginning thirty years ago. At that time New York City's millions faced the danger of water shortage, but remembering their experience with neglect and corruption in the building of the second Croton aqueduct, they feared to undertake a new supply. The times were heavy with political pressure. An independent board was finally set up, with Smith as engineer. His task involved extraordinary technical difficulties, yet these were surpassed by the problems of organizing and conducting the work so as to avoid the numberless pitfalls that might engulf the enterprise. With great wisdom and consummate skill in human relations he initiated and carried out the great task; and throughout its twenty-year duration he kept it steadily and securely on its course, free from question, attack or interference. Engineering judgment and intuition of highest order were essential parts of his equipment, of course, but to these he joined a great power over men—an almost magical ability to inspire loyalty and affection in all who worked for him, and at the same time to disarm and convince his opponents. Integrity, simplicity and justice, and a homely New England shrewdness combined to create this power. These qualities built the aqueduct. And these same qualities together with his ever-youthful spirit endeared him to everyone who was privileged to be his friend. The Catskill aqueduct stands as a monument to Smith, one of the greatest engineers of his time and a master of human arts.

Road Work Below Normal

CURRENT discussion indicates that many people believe the amount of roadbuilding under the recovery program to be abnormally large. Highway engineers know the falsity of this belief, but they will nevertheless welcome the definite figures which W. C. Markham laid before the state highway officials last week. These figures establish in cold arithmetic that less money is to be spent by the states this year and next than was normally spent before the 1932 emergency act increased the federal aid contribution. The deficit this year over last is $175 millions, while next year's shortage will be even larger. Mr. Markham's figures tell a clear story so far as state roadbuilding is concerned, but to make the picture complete the road operations of counties, towns and cities should also be accounted for. This additional field normally provides as much work or more as that done by the state, while for 1933 and 34 it will show only small activity. The total deficit in road work is therefore much larger than the figures above quoted. Far from being inflated to extravagant volume, roadbuilding is greatly below normal.

Work All Winter

THE LATE AWARD of emergency-public-works contracts makes winter work inevitable. If present contract awards are regarded merely as orders for jobs to be started next spring the purpose of the Recovery Act to put men, equipment and materials to work will not be met. Therefore no single construction project should be permitted to mark time through the winter. Nor need it do so. Winter construction is entirely feasible, requiring only the determination of the contractor and authorities involved to carry on. Cold-weather methods have been so greatly developed that all normal operations can proceed in any but the most inclement period. The belief that winter work is warranted only on large projects is disproved by the successful prosecution of hundreds of small operations during the past two winters. The Public Works Administration can and should make sure that construction is kept going at full speed through the winter. The course for bidders and contractors to pursue is equally plain—to plan for continuous winter work.

Columbus Sewage Loan

THE LOAN and grant of $3,400,000 to Columbus, Ohio, for sewage plant construction, noted in our news pages this week, bids fair to loosen up the tangle that for the past year has involved this essential improvement. For several years past Columbus has been under the order of the state health department to clean up the Scioto River. Last November the voters, aghast at the prospect of more debts, disapproved a bond issue for building a sewage plant. Shortly thereafter the state supreme court held that orders from the health department are mandatory and are not vitiated by a community's financial disabilities. In a hectic endeavor to discover some means of meeting the health department's requirements without involving taxes or debts, several novel schemes were proposed, including one that contemplated the construction and operation of a plant under private contract. This scheme ultimately failed, but the city officials were led into court to explain their delay in cleaning up the river. Activity then was begun to revise plant designs for lower cost, and another vote on a bond issue was authorized for this coming election period. It is while the project is in this state that the PWA loan is approved. A favorable vote on the bond issue now means that construction can be started without delay.

A Notable Trafficway

DURING the past few years almost every large city in the country has had to provide some major traffic artery to expedite vehicle movement past congested centers. None of these has been more urgently needed than the new Seventh Street Trafficway under construction in Kansas City, Kan. Traffic entering the principal business district, which is in a bottleneck between the Kansas and Missouri Rivers, has now only

one effective outlet to the east—the Intercity Viaduct—and this leads into the congested and hilly commercial area of Kansas City, Mo. The new trafficway collects all this through traffic and bypasses it around Kansas City, Mo. It is a good example of joint effort, for state highways are all being tied into it, the Kansas highway department built the river bridge near the southern end, and a private company is building the bridge at the northern end. In a very real sense the project is also a product of the business emergency, for the Kansas River bridge was built from federal funds provided by the Emergency Relief and Construction Act of 1932, the Missouri River bridge is being built with an R.F.C. loan, and much of the city's part of the job has been done with local emergency money. Such well-directed cooperation and wise utilization of federal credit aid could prove equally effective elsewhere.

Shaping the Future Profession

FOR SOME TIME there have been stirrings in engineering circles that reflected a seeking for better development and organization to adapt the profession to the changing world. Out of these stirrings, which were observable in the colleges and societies as well as in the professional corps itself, has now crystallized the Engineers Council for Professional Development, which came into permanent existence last week. It is doubtful whether the profession in its growth has experienced an earlier movement as interesting and as full of potentialities for good.

According to its charter the Council, a joint body of seven major societies, aims to raise the plane of qualifications and performance of engineers through educational aid and through recognition of professional attainment. This purpose is to be carried out under a four-point program embracing selection of students, accrediting of engineering schools, promotion of postgraduate continuation education, and establishment of a harmonized membership grade system. Its execution is in the hands of men who have read the signs of the times and are conscious of today's demand that traditions be reviewed and the systems of the past rebuilt wherever need be.

Formation of the Council followed upon the work of an intersociety Conference on Certification into the Profession, which in turn was the expression of questions that had developed from the establishment of state licensing. The great societies were not ready to accept the doctrine that the civil world through license should control membership in the profession; they felt that this should preferably be done by the engineering body itself. Thus the Council in one aspect is the profession's answer to the challenge of the licensing system, and expresses the purpose of setting up a controlled structure more perfect than one dependent on state license alone.

Other forces contributed to the movement. Some of them were due to the continuous economic shift by which engineers have been drafted increasingly into operation and control, as well as into activities quite outside the engineering field. Some grew out of questions arising between the colleges and the professional groups, as crystallized in the Wickenden study of education. Yet other forces arose from the continuing differentiation of professional groups and the failure of technical societies with respect to professional development and control. All these causes tended to bring a realization that some means of unification ought to be found in order to make the profession a well integrated, competent and efficient service agency.

Through the ECPD, unification is to be sought primarily by setting up a uniform definition of engineering qualifications and so far as possible bringing the recognition practices of college, society and licensing authority into harmony with it. This may seem to imply restriction and departure from that free individualism which has distinguished the engineering field since its early day. Engineers may question the Council's aim of establishing a closely controlled professional organization, since they know that creative thought and activity are likely to suffer from regimentation. But they also know that the conditions which permitted a shoemaker to become a great canal engineer and a machinist to develop into the leading steam-engine designer of his time no longer prevail, and that control and definition by adequately high standards are today inevitable.

That part of the Council's program which tends to shape professional organization may find full acceptance by the rank and file of engineers only after careful consideration. But the educational part of the program is sure to obtain immediate enthusiastic support. The Council's attempt to make a better profession by making better engineers is the highest and perhaps ultimately the most influential part of its work. Free cooperation of society and school, and the establishment of a system of continuation education for the young men of the profession, are activities of great possibility for good. It will probably never be possible to establish in advance from among those who enter college the men destined to become engineers, for engineering eugenics is still an unknown science. But it is wholly practicable through the free partnership of college and society to serve the improvement of both.

The present initial program of the ECPD may prove to require progressive revision and extension as its weak spots and hazards become evident. Chief among these is the difficult problem of defining the engineer in terms covering adequately the diverse fields of his activity. If the profession actually is a unit it should be possible to outline a defining pattern; yet such a prominent educator as Dean Kimball of Cornell doubts whether this is possible. Another difficult question is to what extent the college and the society can be linked together without hazard to either of these inherently independent agencies.

Many imponderables also have to be dealt with, for human problems are not amenable to the treatment applicable to inanimate material. In this respect therefore the work of the Council is not a scientific or engineering problem, and the members of the ECPD necessarily must step out of their part as engineers and develop new methods for dealing with the task. Here, however, lies a test of the profession itself. How it succeeds in handling the self-imposed responsibility will show whether it has yet adequately broadened its power to be able to direct not merely things but also the men and movements that influence the world's advance.

The great hopes reposed in the new movement rest only in part on the qualification and vision of the men now directly participating in the movement. They reside chiefly in the response of the profession as a whole. Without active aid from the majority of engineers, the Engineers Council for Professional Development will have limited power. But if this support is gained and if the activities of the Council are directed to the interests of the world as a whole, its date of birth may mark a decisive epoch in the profession's history.

NEWS OF THE WEEK

Public Works Board Makes Large Loans For Municipal Work

LOANS AND GRANTS for municipal work under the Public Works Administration for the week ending Oct. 14, amounted to over $38,000,000. With the allotment made for federal projects, the new construction authorized during that week totalled close to $50,000,000. Details of the non-federal projects are given in the accompanying table.

Chicago gets $8,000,000

The largest single item for municipal construction was a loan and grant of $8,000,000 to the Sanitary District of Chicago for completing five contracts let by the Sanitary District in 1931, but on which work had been suspended for lack of funds. In making the allotment Secretary Ickes said, "The Public Works Administration reserves the right to call for new bids to complete the Sanitary District's work. The Public Works Administration will buy at par $8,000,000 worth of Sanitary District bonds, but will hold all these bonds until the Sanitary District shall have repaid 70 per cent with interest, whereupon the PWA will return the remaining 30 per cent. In other words, on account of the financial situation of the district as evidenced by prior default on its bonds, there will not be made a 30 per cent grant at the beginning of the work. But, in effect, we will hold the 30 per cent as an additional security for the loan of 70 per cent."

Other large allotments

Other large allotments included $1,500,000 to Franklin County and the State Roads Department of Florida for a toll bridge across Apalachicola Bay; $1,430,000 to San Antonio, Texas, for a trunk sewer and lateral systems and an extension to the sewage treating plant; $2,500,000 to Arlington County, Va., for a sanitary sewer system and primary treatment plant; and $3,000,000 to the city of Danville, Va., for a 10,000 kw. hydro-electric power plant including dam and tunnels. This is the first allotment for a municipal power plant. A loan and grant of $2,600,000 to the Red Bluff Water Control District, Pecos, Texas, for an earth dam, power plant and transmission line, also was authorized. A loan and grant of $2,500,000 to Salt Lake City, Utah, was made for general municipal improvement work and two loans and grants were made to the city of Columbus, Ohio, one of $3,400,000 for an activated-sludge sewage treatment plant and one of $1,800,000 for intercepting sewers.

Large grants to San Francisco

Thirteen grants totalling $5,895,000 were authorized to be made to the city of San Francisco for a number of municipal projects. They include a grant of $798,000

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Edward M. Markham Appointed Chief of Engineers, U. S. Army

Edward M. Markham, Colonel, Corps of Engineers, division engineer, Great Lakes Division, Cleveland, was appointed Chief of Engineers, U. S. Army, by the President on Oct. 17 and raised to the rank of major general. He succeeds Major General Lytle Brown whose 4-year term of office expired on Oct. 1. Appointment of Colonel Markham, one of the younger officers of the rank of colonel to the position of Chief of Engineers follows out a precedent established when General Brown was appointed of naming a man to the position of Chief of Engineers who would be able to fulfill the four-year term before his retirement on account of age.

Court Will Not Reconsider Chicago Drainage Case Decision

The United States Supreme Court, at the opening of its fall session on Oct. 9, refused to reconsider the decision reached in its last term requiring the state of Illinois to finance the sewage disposal work at Chicago if the Chicago Sanitary District is unable to finance the work through the sale of its own bonds. The Supreme Court in May of this year (*ENR*, May 25, 1933, p. 696) ordered the state of Illinois to arrange for completion of the sewage disposal plant by Dec. 31, 1938, in order that the diversion of water from Lake Michigan might be reduced to 1,500 sec.-ft. by that date.

Land Purchased for Homesteads Under National Recovery Act

Acting under the subsisting homestead provisions of the Recovery Act, the Subsistence Homestead Division of the Interior Department, on Oct. 12, announced that it had purchased 1,100 acres of farm land in Preston County, near Morgantown, West Virginia, on which to establish a demonstration project in decentralized industry for 200 families. Unemployed coal miners from the surrounding region will be used. Homes will cost about $2,000 and will be paid for over a period of 20 years. The Recovery Act provided $25,000,000 for this purpose. The Morgantown project includes construction of a factory to make products required by the Post Office Department

Unemployed Engineers in Canada Aided by Engineering Institute

Relief measures taken by the Engineering Institute of Canada have resulted in the placement of a considerable number of unemployed engineers, according to a statement made by R. J. Durley, Secretary of the Institute, before its Montreal branch on Oct. 5. Sixty-five men were placed through bulletins and service records sent to prospective employers and 92 members have been placed in supervisory positions in relief camps throughout Canada.

Low-Cost Housing Progresses Steadily Under PWA Program

PLANS for the low-cost housing program have been progressing steadily, with the proposed federal housing corporation occupying principal interest. Also in addition to notable progress in Cleveland and Euclid, Ohio, new loan allotments have been announced for projects in San Francisco and Atlanta. A contract was let in Philadelphia last week.

Construction of low cost housing for lease or sale, using federal funds would be a radically new departure from existing practice for, according to Secretary Ickes, the plan contemplates doing the work "without the request or aid of the city." Current projects for which loans have been allotted are all sponsored by private limited-dividend companies. A public housing authority district has been set up in Cuyahoga County (Cleveland), Ohio, for the purpose of building and operating low-cost housing, and some cities, such as Detroit, Milwaukee and Los Angeles, have municipal laws which permit public housing, but so far no definite progress has been made in this field. The studies of a set up for a federal housing corporation, it is understood, are still actively underway at PWA headquarters in Washington.

Cleveland's financing

In Cleveland, the first method proposed for financing the local share of the cost of the approved housing was found to be impracticable In the original proposal the federal government was to take a first mortgage in the amount of its loan of $12,000,000, while the $2,000,000 of local equity required was to be financed by a second mortgage. Cleveland banks being by law barred from handling second mortgage paper could not cooperate in such financing. The proposal was then made to Washington and finally approved that a first mortgage of 60 per cent of the $14,000,000 total cost and a second mortgage of 40 per cent be used as the basis for financing. Under this arrangement, Cleveland would be allotted $1,000,000 of first mortgage bonds and $1,000,000 of second mortgage bonds, while the federal government would take the remainder of both first and second mortgage bonds. The local banks could thus take some of the first mortgage bonds, while the second mortgage bonds, in part at least, will be used to pay for construction materials and engineering and architectural services. At present it is contemplated that materials dealers, engineers and architects will be asked to take 15 per cent of their pay in second mortgage bonds.

Euclid ready to work

Final contract for the $1,000,000 housing project in Euclid, Ohio, has been signed.

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J. Waldo Smith Dies at 72

Former chief engineer of Catskill water supply project dies of sudden heart attack

J. WALDO SMITH, chief engineer of the board of water supply of New York City during the construction of the Catskill water supply system, and consulting engineer to the board since his retirement in 1922, died suddenly of heart failure on Oct. 14 at his residence in New York City. He was 72 years of age. Due to the condition of his heart, Mr. Smith in recent months had spent most of his time at his home in the Catskill Mountains; he had come to New York to attend an anniversary dinner of an old friend on water supply work in New Jersey, and was preparing to go to the dinner when the fatal attack came.

J. Waldo Smith is best known for his work as chief engineer on the Catskill water supply system. He organized and directed that $175,000,000 undertaking throughout, including the great aqueduct to New York City with its deep siphon under the Hudson River. But his active career included a major part in the planning and construction of many other water supply systems.

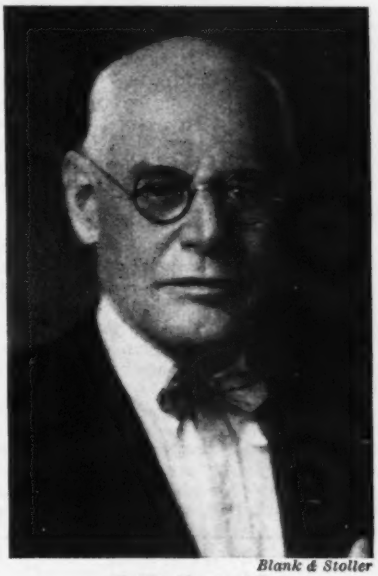
Born in Lincoln, Mass., March 9, 1861, Mr. Smith, while still in his teens, assisted in the construction of a small supply system for his home town and at the age of 17 was placed in charge of the pumping plant, acting as fireman, engineer and general superintendent. Later, he atended Phillips Academy in Andover, and at the age of 20 became an assistant in the office of the Essex Company under Hiram F. Mills, chief engineer. His work there showed him the necessity of a technical education, and accordingly he entered Massachusetts Institute of Technology, graduating in the class of 1887. During the summer vacation in 1884 and 1885 he served as an assistant with the Holyoke Water Power Co.; after graduation he was with the company again until 1890.

In 1890 Mr. Smith became connected with the East Jersey Water Co., and during the following 13 years was engaged in the construction of an extensive system of reservoirs and pipe lines to supply towns in northern New Jersey, his work there culminating in the design and construction of the filtration plant at Little Falls, first modern mechanical water filter plant in the United States.

Mr. Smith was appointed chief engineer of the Aqueduct Commissioners of New York City in 1903, and under his direction the new Croton dam, then the largest masonry dam in the world, was completed, as was the Muscoot dam, the Jerome Park reservoir and the design for the Cross River dam.

In 1905, when the great project to obtain an additional water supply of 500 million gallons a day from the Catskill Mountains finally was authorized, Mr. Smith was named chief engineer of the newly established Board of Additional Water Supply. Work on preliminary plans was begun in August and was pushed at such speed that they were ready for approval by the Board of Estimate in October. Detailed plans and drawings were begun at once and the first contract was let in the spring of 1907.

Under Mr. Smith's direction the Ashokan dam was built, the Kensico reservoir enlarged, and the aqueduct to New York City built, including the pressure siphon which passes under the Hudson River between Storm King and Breakneck Mountain at a depth of 1,100 ft., also the 18-mile city aqueduct tunnel under New York City. The completion of the first stage of this work, the actual delivery of over 300 million gallons of water to New York City, was accomplished in October, 1917, more than one year ahead of the estimated time and within the estimated cost. Subsequently, development of the Schoharie watershed was undertaken, including the construction of the Gilboa dam and driving the 18-mile Shandaken tunnel. The latter project had been carried through to the contract stage when, in 1922, after 17 years of active direction of the work, Mr. Smith asked the board of water supply to pass the responsibility for carrying through the work to a completion to the men under him in order to give him time for a fuller study of the future problems of the system. At that time he said, "I would not think of taking this step if there were not others entirely familiar with the work who by experience and ability are capable of directing the work. It has been one of the features of this organization throughout to train men to accept responsibility and be familiar with the duties of their immediately superior officers, so as to be capable of assuming the position if it becomes vacant by resignation or otherwise."



Blank & Stoller

J. Waldo Smith

Since his resignation Mr. Smith, in addition to his consulting work for the board of water supply of New York City, has acted in a similar capacity for the cities of Philadelphia, St. Louis, Boston, Hartford, Kingston, San Francisco and Vancouver and as consulting engineer on the Moffat Tunnel.

In 1918 the four founder engineering societies conferred the John Fritz Medal upon Mr. Smith, and in 1928 the American Society of Civil Engineers elected him to honorary membership.

Mr. Smith's exceptional abilities and character are reflected more adequately in the following words, written at the request of *Engineering News-Record* by one of his intimate friends, associated with his work for many years past:

"It is seldom possible from a categorical recital of the accomplishments of an individual to glean anything as to the true inwardness of the man. Every normal person admires success and feels respect for him who has earned it. The winning of distinction is significant of greatness and of quality. But from what roots does greatness spring and wherein lies its essence? I am writing these words because you have asked me out of my long friendship and love for Waldo Smith to analyze, as best I may, the reasons for the fulness of his life and the great measure of distinction he achieved in the hearts and minds of all with whom he came into contact And this is most fitting because Waldo Smith fully as much as any engineer of the period exemplified the highest ideals of the profession. His mind and heart were a book as open as his office door, which was never closed. Nothing was ever said or done in that office which could not have been shouted from the housetops. His door was always open to those who came and no previous appointment was needed.

"Sprung from a long New England ancestry, he inherited those qualities of fairness, of economy and of rugged honesty which controlled and characterized his every thought and action. No matter what question came to him, his primary concern was that his decision should be just and that the equities should be balanced. Had he followed the law he would have been a great judge. But Waldo Smith was an engineer by nature. He could determine the value of a plan almost at a glance, and his mind at once went forward to the effects which would follow from the plan. To him the details of a structure pictured an operating whole; the plan for a project visioned the social, the economic and the political consequences to which it would give rise. Yet his reports were models of brevity, though full and complete.

" As an engineer he worked not only with materials but even more brilliantly with men—both the men who put the materials from the drafting board into the completed structure and the public officials who provided the necessary funds and approved his plans. Waldo Smith worked with men as one of them. As they had ability he recognized it, as they had faults he overlooked them. He was the engineer and director of men because he held the respect and confidence of all.

"His qualities were brought into outstanding relief by his great personal modesty. Never did he seek publicity or notice for himself. Always did he insist that credit should go to the men who deserved it, and always did he particularly remember those who served with faithful distinction. The organization he built up on the Catskill Aqueduct was one of socialized service, and partly because of this fact its spirit and loyalty were boundless and its influence has gone far and wide. Each man of his staff as well as everyone of the many contracting organizations which executed the work saw in him the exemplification of all that was good and noble and true. His friends were legion. They were his strength and his comfort.

'None knew him but to love him
None named him but to praise'

" The friends of Waldo Smith will miss his genial presence, his sound counsel and his fearless honesty. The profession will be the poorer for his passing."

Public Works Board Makes Large Loans For Municipal Work

(*Continued from p. 482*)

to defray part of the cost, estimated at $3,500,000, of raising the height of O'Shaughnessy Dam by 85.5 ft.; $2,695,000 for extensions to the water supply system, estimated to cost $12,000,000, and $1,400,000 for a 200,000 kw. hydro-electric plant in Tuolumne County, estimated to cost $6,308,000.

Army and Navy projects

An allotment of $8,961,052, has been made to the Bureau of Yards and Docks of the Navy Department for the construction of officers' quarters, barracks, hangars, etc., at naval stations. The largest items are $2,000,000 for Mare Island, Calif., and $4,155,000 for Pearl Harbor, Hawaii. The Navy Department also got $225,000 for sanitary sewers at the naval academy at Annapolis, Md.; $535,887 for new mechanical and handling equipment in the navy yards, and $1,530,000 for radio communication facilities at ten stations.

The War Department received an allotment of $3,600,000 for channel stabilization work on the lower Missouri River between Kansas City and the mouth, most of which will be spent for channel contraction and bank protection between Kansas City and Hermann, Mo.

An allotment of $15,500,000 has been made for the first year's work on the Fort Peck Dam and reservoir in eastern Montana, 12 miles above the confluence of the Milk River with the Missouri River. It is designed to conserve water for navigation on the Missouri River.

The Department of Agriculture has received $110,975 for an experimental laboratory at Auburn, Ala., and $1,145,000 for the experiment station at Beltsville, Md., for buildings and land. Three allotments totalling $381,500 were made to the Public Health Service, mostly for the purchase of boats.

Texas relief work

A grant of $2,670,000 as part of a drought relief and highway program costing $8,900,000 has been made to the state of Texas. This is in addition to the $24,244,000 allocated to Texas from the highway fund. The balance of the program will be financed by the Federal Emergency Relief Administration.

Flood control work on the Sacramento River in California to be carried out under the direction of the Chief of Engineers, U. S. Army, received $1,500,000 which with $500,000 to be supplied by the state will be used for the construction of levees, channel enlargements and outfall structures.

Administrative expenses

The National Recovery Administration received $3,120,000 from the Public Works Administration for administrative expenses until June 30, 1934, and $10,000 was allocated to the Department of Labor for expense incurred in field investigation of wage scales. The Treasury Department was allotted $315,000 to supplement the previous allotment of $4,828,000 for the New York City Post Office annex, on account of increased construction costs; $77,000 was allocated to the purchase of window fixtures for government buildings in Washington.

DETAILS OF PWA LOANS AND GRANTS FOR NON-FEDERAL WORK

Locality	Loan & Grant or Grant	Type	Man-Months Work Provided	Amount
Shippensburg, Pa.	L. & G.	Water Line	450	$150,000
Chicago, Ill.	L. & G.	Sewage	81,000	8,000,000
Apalachicola Bay, Fla.	L. & G.	Bridge	7,680	1,500,000
Dows, Iowa	G.	Streets	80	4,200
Beaver Dam, Wis.	L. & G.	Sewage Plant	760	210,000
San Antonio, Texas	L. & G.	Sewers	8,400	1,430,000
Pawtucket, R. I.	L. & G.	City Hall	1,750	425,000
Westminster, Md.	L. & G.	Sewage System	1,200	289,000
El Paso County, Colo.	L. & G.	High School	3,000	939,111
Arlington County, Va.	L. & G.	Sewage System	11,000	2,500,000
Danville, Va.	L. & G.	Electric Plant	28,800	3,000,000
Marshall, Minn.	G.	Repair to Sewage disposal plant	80	9,000
Waconia, Minn.	G.	Sewage Plant addition	132	6,000
Longmont, Colo.	G.	Streets	225	6,000
Flint, Mich.	G.	Streets	100	14,000
Harbor Springs, Mich.	G.	Sewers	100	4,200
Longview, Texas	G.	School Bldg	30	2,400
Burlington, Wis.	G.	Reservoir	13	1,000
Central Point, Miss.	G.	School Bldg.	25	700
McLeod County, Minn.	G.	Bridges	992	36,000
Georgetown, S. C.	L. & G.	Water	12	10,000
Pecos, Texas	L. & G.	Power & Irrigation	12,000	2,600,000
Monte Vista, Colo.	L.	Reservoir	520	300,000
Nashville, Tenn.	L.	Dormitory	1,200	400,000
Dillon, Mont.	L.	Mont. Reservoir	300	75,000
Salt Lake City, Utah	L. & G.	Gen. City Impr.	12,000	2,500,000
Wilmington, Del.	G.	High School	5,120	435,000
Columbus, Ohio	L. & G.	Sewage Treatment	13,200	3,400,000
Columbus, Ohio	L. & G.	Intercept Sewer	11,200	1,800,000
Boscobel, Wis.	L. & G.	Community Bldg.	180	64,000
Circle, Mont.	L. & G.	School Bldg.	120	40,000
Brownsville, Texas	L. & G.	Utilities	1,275	200,000
Palo Alto, Calif.	Grant	Sewer	300	29,000
Elbow Lake, Minn.	Grant	Auditorium	125	8,000
Ottawa Co., Kan.	Grant	Roads & Bridges	70	2,000
Peoria Co., Ill.	Grant	Sewer	300	23,000
Brunswick Co., N. C.	Grant	School	36	3,500
Baltimore, Md.	Grant	Sewer	176	9,000
Colorado Springs, Colo.	Grant	Water Dev.	3,500	285,000
Parkwater, Wash.	Grant	Airplane Hangar	200	27,000
Cloverdale, Calif.	Grant	Sewer	30	1,700
Baltimore, Md.	Grant	Fire Eng. House	200	12,000
Wilmington, Del.	Grant	Waterworks	486	72,000
San Francisco, Calif.	Grant	Dam	12,600	798,000
San Francisco, Calif.	Grant	Bldgs.	1,000	77,000
San Francisco, Calif.	Grant	Bldgs.	3,600	354,000
San Francisco, Calif.	Grant	Streets & Blvds.	7,800	464,000
San Francisco, Calif.	Grant	Bldgs.	7,470	666,000
San Francisco, Calif.	Grant	Yacht Harbor Ext;	1,440	203,000
San Francisco, Calif.	Grant	Bathing Beach	1,980	166,000
San Francisco, Calif.	Grant	Water System	50,400	2,695,000
San Francisco, Calif.	Grant	Ext. St. Car Line	160	14,700
San Francisco, Calif.	Grant	Fire System Ext.	5,400	460,000
San Francisco, Calif.	Grant	Sewer	7,800	545,000
San Francisco, Calif.	Grant	Airport Improv.	1,716	53,000
San Francisco, Calif.	Grant	Hydro-Elec. Plant	12,600	1,400,000
		Total	322,333	$38,718,511

Low Cost Housing Progresses Steadily Under PWA Program

(*Continued from p. 482*)

Thus this project, providing for some 300 individual homes built for lot owners with government funds, is ready to go ahead.

New allotments

The San Francisco allotment of $3,230,000, noted briefly last week, goes to the Roosevelt Terrace Housing Development for a project to be built on a site of 19½ acres near the east end of Golden Gate Park. It is stated that the city recently has purchased 5½ acres of this plot for a park. The project will provide 886 apartments totalling 3,048 rooms, which will rent at an average of $11 per room per month. The buildings, all fireproof and covering about 28 per cent of the plot, are mainly four-story walk-ups grouped around a court, which is dominated by a central six-story elevator building.

Two allotments were made for projects in Atlanta, both involving slum clearance. One was to Techwood, Inc., for $2,600,000 for a project for white occupancy. The other, made to the University Housing Corp., was for $1,212,500, for a project planned for negro occupancy. The Techwood project will cover a site of ten city blocks, two of which are to become city parks. It will remove one of Atlanta's worst slums from a main thoroughfare between the business section and the Georgia School of Technology. Accommodations will be provided for 557 families in two and three-story walk-up, fireproof apartments, containing 1,965 rooms. There will also be a dormitory of 160 rooms for students of Georgia Tech. The land coverage is about 25 per cent, exclusive of public parks. The estimated rental will be between $7.50 and $8 per room per month. Citizens of Atlanta are furnishing an equity of $375,000.

The negro project will occupy six city blocks adjacent to Spellman and Atlanta Universities (both negro). The buildings will be three-story and fireproof. The new housing will consist of 800 apartments of three and four rooms each. The average rental per room per month will be between $4.50 and $5.00.

First housing contract

In Philadelphia, Hillcreek Housing Corp., which had received an allotment of $1,290,000, has let a contract for construction, the first for PWA housing. The project includes 6-room residences and 3-story apartments adjacent to Tacony Creek Park and near an industrial area 6 miles from the city hall.

Public Works Administration Takes New Steps to Speed Projects

WAYS AND MEANS of decentralizing legal procedure now are being considered by the Public Works Administration in an effort to reduce the long lapse of time between allotment of funds and final execution of contracts for state and municipal projects. Despite the speed with which the headquarters staff is now acting on applications, the actual disbursement of funds still is a mere dribble.

To reduce legal delays

The principal obstacle to getting work under way before cold weather curtails operations is the maze of legal requirements with reference to bond contracts and other steps required to establish the eligibility of the applicant and its financial responsibility. Complications are introduced by the variations in legal practice as between the several states. This has handicapped the PWA's legal staff which is centralized in Washington, although an effort has been made to build up personnel that as a group is familiar with state laws and rules of practice throughout the country.

Except for the standard labor provisions, no two bond contracts which evidence the loan by PWA and the applicant's obligation to repay are exactly alike. Just how this multilateral legal procedure may be rendered more flexible, and more liberal as well as speedier, presents a problem that is as confounding as has been the attempt to comply with the variety of requirements that such formal documentation imposes.

Having succeeded in speeding up its own machinery in making allotments and finding that this is futile unless subsequent formalities also are abridged, PWA now is convinced that this can only be accomplished on the ground in the several states. Whether this resolve will be carried through by delegating more authority to state advisory boards remains to be seen. It seems obvious that legal personnel will be needed at state headquarters, whether furnished by assignment from Washington or by appointment of lawyers in the state.

Speeding up work

In its desire to get construction actually going throughout the country, the PWA also is considering what can be done to get action from laggard state advisory boards. This was intended to be the function of the several regional advisers but such supervision has not been effective except in a few notable instances.

Administrator Ickes this week requested state advisory boards to stop passing the buck to Washington by endorsing bad projects. It appears, he said, that in some instances state groups are afraid to say no, with the result that valuable time is wasted in Washington. The criticism is stated to apply to a certain few states where the boards are subject to particular pressure in behalf of certain projects. Mr. Ickes emphasizes that the members of state boards are federal officials and are responsible to the people of the United States rather than to their local communities.

Carrying its drive for action right through to the job, the PWA now is permitting construction on force account. In order to satisfy itself that funds are properly safeguarded in every case, no set rule has been adopted for allowing force account work. Circumstances will govern in every case. In general, PWA still prefers contract work.

Legal remedies proposed

Because of the existing legal delays, said Henry T. Hunt, General Counsel of PWA, on Oct. 17, it appears that no large part of the $1,600,000,000 available for state and municipal projects can be spent this year, and that its effect will not be substantial until 1934. By January 1, he estimates, allotments to states and cities will total $1,250,000,000.

Several methods of reducing legal delays have been outlined by E. H. Foley, Jr., assistant general counsel. Removing statutory restrictions will take too long for emergency purposes. In the case of purely statutory restrictions the first step is to pass a revenue bond act, permitting a pledging of the revenue from the particular project involved for repayment of the bonds, thus avoiding placing additional burdens on taxpayers. A second step is to authorize cities to borrow from the PWA without regard to statutory debt limits and to dispense with the requirements of referendum elections, notice of hearings and other time losses, such as requirements of public sale. The recently passed New York law, chapter 782 of the laws of 1933 should however be used as a model only with care as it is declared to be ambiguous and ineffective in certain respects.

The third possible method is to make the raising of the debt limits dependent upon review by a state commission, which commission may authorize the municipality to incur indebtedness to the United States which shall not be included in computing the statutory debt limits (chapter 2078, Rhode Island laws of 1933). The fourth method (chapter 26 of the acts passed by the extra session of the general assembly of Virginia in 1933) swept away all statutory limitations on the issuance of bonds for a limited period of time and only for PWA loans and grants to the counties, cities and towns. This is considered the best method.

Simple procedure for grants

Cities that apply only for the federal grant of 30 per cent of the cost of labor and materials and finance the remainder of the cost by borrowing elsewhere than in Washington are in a position to get final action without delay as the contract covering the grant is much simpler than that involving purchase of bonds by PWA. In the latter category of applications, local debt and tax limitations constitute an obstacle that is difficult to surmount. Concentration by PWA on legal snarls may remedy this situation to some extent and, if litigation holds out any promise, the PWA will participate in test suits.

Wage scale questions

The PWA minimum wage scale is blamed for the reluctance of many cities to undertake construction of public improvements. There is no evidence that Administrator Ickes will reconsider the rates agreed to by the trade unions. The PWA scale must be paid on all jobs financed wholly or in part by the federal government. This includes projects on which the PWA's disbursement is limited to the 30 per cent grant.

The wage rate provisions cannot be escaped by deliberate stratagem as, for example, a division of costs under which PWA would pay for materials by grant or otherwise, leaving the local community to pay the labor on its own wage basis. This idea found favor in several towns because of the large number of men on relief rolls who are willing to work for a very low wage. It is possible that federal funds appropriated for direct relief may be combined with public works funds to create more employment but the PWA scale will stick, according to PWA officials.

Winter work

Except to give right of way to projects in northern states as fast as they are submitted, there is little that the PWA can do specifically to encourge winter work. All contracts between the borrowing municipality and the construction firm include time limits of the usual nature. Federal inspection is relied upon to assure performance in accordance with the contract.

Incomplete plans that presumably are due to the inability of applicant communities to hire engineers litter PWA desks in Washington. PWA will not advance funds for preparing plans because, says Mr. Ickes, the project may subsequently be disapproved and the money wasted.

Federal housing

Creation of a federal corporation to undertake construction of lowcost housing in communities throughout the country is waiting upon scrutiny by Henry T. Hunt, PWA chief counsel, of the tentative articles of incorporation. PWA favors the direct undertaking in order to give wider scope to the housing feature of the public-works program than is possible by financing limited-dividend corporations and the comparatively few cities that either by reason of their "home rule" status or specific state housing law, as in Ohio, can engage in construction.

The extent of the federal government's program will depend on developments. The federal corporation should, in Administrator Ickes' opinion, be able to provide housing at a lower cost per room than the limited dividend corporation but he explained that the field is so wide that there would be no excuse for competition. The federal corporation would be financed by purchase of its capital stock from PWA funds and eventually a revolving fund would accumulate from the proceeds of sale and leases. The corporation would have the right to condemn land for house construction, which many cities cannot do.

All together, it is believed that the housing program would move forward much faster under the direct federal undertaking than it has to date. Sixteen projects have been tentatively approved representating loans by PWA, totaling $46,000,000. From 150 to 175 projects are pending, but expeditious action is retarded by many complications. Many of the limited-dividend corporations are finding it hard to raise the required equity of 15 per cent, although PWA is willing to finance the remainder. Land desired for development is held at a high "nuisance" value. The first municipal project, that of Detroit, is still to come. If approved this project is eligible for a 30 per cent grant, which is not available to limited dividend corporations.

New River Case Dismissed By Court of Appeals Order

The now-famous suit brought by the Appalachian Electric Power Co. against the Federal Power Commission to test the commission's right to exercise control over power plants on the non-navigable sections of rivers has been ordered dismissed by the United States Circuit Court of Appeals of the Fourth District. The court maintained that it had no jurisdiction and that the district court was in error in accepting jurisdiction. The lower court decision (*ENR*, April 6, 1933, p. 446) had upheld the power commission in its claim to jurisdiction over the power company's proposed New River hydro plant.

The Appalachian Electric Power Co., with the approval of the state of Virginia, undertook to build a water power plant on the New River, a major tributary of the Kanawha River, but declined to apply to the Federal Power Commission for a full license on the ground that the river is not navigable. The commission, however, maintained that its jurisdiction extended to the New River as control of its flow would affect navigation on the Kanawha and demanded application for a license before the work could start.

If upheld in its claim, the commission's jurisdiction would be extended to practically all the rivers of the country.

Dismissal of the present suit means that a new effort will have to be made to get the subject before the Supreme Court before the question at issue can be decided.

Subway Proposed for Cleveland

Construction of a subway from the east end of the Detroit-Superior high-level bridge in Cleveland to Euclid Ave. and 107th St. is proposed in a resolution adopted by the transportation committee of the city council of Cleveland, asking the mayor's recovery committee to include such a four-track subway in its public works program.

SOCIETY CALENDAR

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual meeting, Chicago, Oct. 17-21.

HIGHWAY RESEARCH BOARD, National Research Council, Washington, D. C., Dec. 7-8.

NATIONAL CONFERENCE ON LOW-COST HOUSING, sponsored by the Cleveland Engineering Society, is to be held in Cleveland Oct. 25-27.

OHIO STATE PLANNING CONFERENCE will hold its annual meeting at Columbus, Ohio, Oct. 19-20, with sessions at the Ohio State University and at the Deshler-Wallick Hotel.

ROCKY MOUNTAIN SECTION, American Water Works Association, will hold its seventh annual meeting at the Park Lane Hotel, Denver, Colo., Oct. 24-26. At the same time the Third Annual Waterworks College of the University of Colorado will be held. A special item of interest will be an exhibit of the working model of the vortex sand trap being developed for use at Boulder Dam.

CENTRAL STATES SEWAGE WORKS ASSOCIATION meeting Oct. 12-13 in Indianapolis covered advances in chemical treatment, in mechanization and in trade waste control, odor control, revenue and service charge financing, handling delinquences and PWA. The association is to give $20 cash awards hereafter for the best paper on science and treatment of sewage. H. F. Ferguson is the newly elected president. M. M. Starr Nichols and O. M. Leonard, vice-president, and Gus H. Radebaugh, Urbana, secretary-treasurer. The next meeting will be held in Wisconsin, the date and place left to the executive committee.

Municipal Activities Suspended Due to W. Va. Court Decision

Complete suspension of municipal activity in several cities in West Virginia and a financial crisis of extreme gravity have resulted from a decision by the West Virginia Supreme Court on Sept. 18 that interest and amortization charges on outstanding municipal bonds must be met from the limited tax revenues now available, and must take precedence over expenditures for service operations. Tax revenues are extremely low, as the result of a recent constitutional amendment, and in many cities are less than the amount required for debt service.

In November, 1932, the voters of West Virginia approved by an 8 to 1 vote a constitutional amendment classifying taxable property into four categories and setting a tax rate limit for each category. On March 7, 1933, the state supreme court held that tax levies to serve a proposed bond issue would have to be within the new constitutional limits. Four days later the legislature passed a law authorizing governmental subdivisions to impose a levy necessary for current expenses to the extent of the maximum levy and to make additional levies for debt charges. Shortly thereafter court action was brought to enjoin the city of Huntington from levying taxes that would total more than the new constitutional limits. This injunction the court granted. In its decision it announced that "Regardless of constitutional limits on levies, old obligations must be paid and paid from restricted levies before any money is given to current expenses."

As an example of the effect of this decision on the various municipalities, the case of Morgantown can be cited: All the money obtainable under the maximum levy in Morgantown is required to pay bonded indebtedness and there is nothing left for operating expenses, except those received outside the general tax levy which are all of a small amount and hardly worth consideration. This city is now without funds to operate its fire department, police department, maintain streets, maintain sewerage and garbage disposal, city lighting and cost of administration of the government.

Similar conditions are in effect in Wheeling, Huntington, and other cities.

Briefs were filed on Oct. 13 by the state attorney-general for a rehearing of the case. The governor, meanwhile, has appointed a committee to devise remedial measures.

Public Health Engineers Discuss Sewage, Water and Refuse Problems

PUBLIC HEALTH engineering is only one of ten sections of the American Public Health Association which held sessions at the 62nd annual meeting, Oct. 9-12 at Indianapolis, but it carried on throughout the week, with joint sessions with the State Sanitary Engineers Monday and the Central States Sewage Works Association Thursday. Sewage, refuse and pollution topics predominated, with some attention paid to water, city growth, and plumbing. In the laboratory section, reports on standard methods, water pollution studies, swimming pools, B. coli reactions, aerogenes detection and germicidal efficiency of chloramine-T were covered.

C. K. Calvert, Sanitary District of Indianapolis, described the sanitary works which handle both sewage and garbage on one site. Cost of collecting refuse in 1932 was $2.51 per ton. Garbage was handled in 1932 by reduction at a cost of $3.25 per ton, or with interest and depreciation added at $6.00 per ton. Over a 5-yr. period the by-products have returned $3.30 per ton, operating costs were $3.52 and interest and depreciation have added $2.68 per ton. Sewage comes from 375,000 people and represents an equivalent population 673,000. At present both activated and primary sludges are digested in deep earth pits. For several months the plant has been operated without return of sludge, a 60 per cent over all reduction of B.O.D. being obtained. This method of operation permits a greater volume of sewage to be handled.

In his discussion of "Liquid Wastes" Langdon Pearse, Sanitary District of Chicago, outlined the improvements of the last 30 years. In an 80-p. report of the committee on sewage disposal, of which Mr. Pearse is chairman, appears an exhaustive statement with full bibliography on the use of chlorine in sewage treatment. Conclusions reached as to the effect in reducing B.O.D. are as follows: (1) Chlorination to residuals of 0.2 to 0.5 p.p.m. after 10 min. reduces B.O.D. (5 day) from 15 to 35 per cent; (2) each part per million of chlorine absorbed causes a reduction of 2 p.p.m. of B.O.D.; (3) the behavior of normal organisms by chlorine is disturbed sufficiently in sewage effluents to make further research essential before proper interpretations of B.O.D. results can be made; (4) chlorination to the point of free chlorine in a stream retards normal decomposition processes; and (5) effects of excess chlorine in a heavily-sludged stream may be negligible in maintaining aerobic conditions.

Harrison P. Eddy Jr., in his paper on "Improvement of Refuse Collection Methods and Disposal Systems" stated that service charges were worth while, as it made the department independent. Continuous instead of intermittent use of incinerators reduces first cost. Collection can often be improved by selection of suitable equipment. Efficiencies depend on the operating management. Engineers can be used to good advantage for operators.

In reporting on the status of the program of the Tri-State treaty on abatement of pollution of harbor and coastal waters within the New York metropolitan area, F. S. Tainter, engineer, New York, said that while the three states, New York, New Jersey and Connecticut, have not yet signed up, that sentiment is favorable.

Keeping up with the demand for adequate pure water said Harry E. Jordan, Indianapolis Water Co., involves such items as standards, adequate treatment and metering.

Hardness is not harmful according to John R. Baylis, Chicago, reporting for the committee on water supply which has studied the effect of chemical constituents in water on the human system. Iodine is best given by salt rather than in water, in the opinion of the committee.

Personal Notes

A. GORDON BAILEY, a civil engineer of Woodstock, N. B., has been chosen town manager of Woodstock by the town council.

JOHN STRANBERG has been appointed city building inspector for Sheboygan, Wis., to succeed Rudolph R. John, resigned.

J. W. PFAU, acting chief engineer of the New York Central Lines, Buffalo and East, has been appointed chief engineer, effective Sept. 1.

C. M. MC CORD has been appointed superintendent of the Memphis Water Department to succeed James Sheahan, who died last June. Mr. McCord takes charge at once.

WILLIAM JUDSON GRAY, consulting engineer of Springfield, Mo., has been named engineer examiner in the Missouri office of the Federal Public Works Administration.

J. ALAN FLEDDERMAN has been appointed chairman of the Public Improvement Commission, Baltimore, Md. The new appointee succeeds H. Webster Smith, who resigned recently.

J. WEBB HOOVER, Everett, Wash., has been named engineer in charge of secondary highways for the Washington state highway department. Mr. Hoover was former state highway engineer.

LEO BAYLES REILLY, formerly engineer of construction, has been appointed division engineer in the bridge and ferry division, Public Works Department of Boston, Mass., to fill the position made vacant by the death of John E. Carty.

HAROLD E. WESSMAN has been superintendent of the water department of the city of Rockford, Ill., since May 1. Mr. Wessman was formerly associated with Waddell & Hardesty, consulting engineers of New York City.

BRENT S. DRANE, construction engineer of Charlottee, N. C., has been appointed engineer-examiner for the North Carolina Public Works Administration. Mr. Drane was formerly chief engineer for the Lassiter Construction Co. of Charlotte.

CHARLES A. PARK, formerly superintendent of lightouses of the Eleventh Lighthouse District, Detroit, Mich., has been appointed chief engineer in the Bureau of Lighthouses, Washington, D. C., succeeding H. B. Bowerman, retired.

J. VERNON OTTER, instructor in engineering drawing at Ohio State University, has been granted a leave of absence to accept appointment as engineer examiner for the Idaho Advisory Board of the federal Public Works Administration.

GILBERT L. YETTER, formerly materials engineer in the Bureau of Construction and Repair, Navy Department, has been appointed welding engineer for the Bureau of Reclamation, Department of the Interior, assigned to the Boulder Canyon project.

S. B. NELSON, consulting engineer of Kansas City, Mo., became chief engineer of the Missouri State Public Service Commission on Oct. 1, succeeding J. E. Flanders. Mr. Flanders has been named valuation engineer.

J. S. M. WHARTON has been named president and general manager of the Consolidated Water Co. of Utica, N. Y., succeeding Franklin C. Hopkins, who has been elected chairman of the board of directors. Mr. Wharton comes from Philadelphia, where he has been an engineer and executive of the General Water, Gas & Electric Co., the holding company of the Utica Corp.

Obituary

FREDERIC V. PITNEY, former president of the Morristown Aqueduct Co., died at his home in Morristown, N. J., on Oct. 11, age 64 years. Mr. Pitney was a graduate in civil engineering from Princeton University in the class of 1890 and devoted much of his time to the Morristown Aqueduct Co. until it was taken over by the municipality.

PATRICK J. SLATTERY, member of the engineering and contracting firm of Slattery-Daino Corp., Long Island City, died suddenly on the golf course of the Westchester County Club on Oct. 7. Mr. Slattery was 42 years old, a graduate of R.P.T. in the class of 1915. He was vice-president of the General Contracting Association of New York City and had been active in subway construction work in the city.

CONSTRUCTION STATISTICS OF THE WEEK

HIGHWAY LETTINGS aggregating $19,297,000 raised the total of the past week's heavy contract awards to a six-months' weekly high of $46,208,000. Road contracts exceeding a million dollars were awarded by Texas, California, New York, Ohio and Missouri. The New York Central's grade elimination project at Syracuse, to be built by day labor at an estimated cost of 3½ millions, accounts for half of the private contract total. Other large awards include: Hillcreek Housing project, Philadelphia, 1.3 millions; Delaware River dredging, 1.5 millions; Winfield lock, 2 millions; Boulder dam generators, 3 millions.

CONTRACTS
(Thousands of Dollars)

	Weekly Average Oct., 1932	Four Weeks	Week Oct. 19, 1933
Federal Government.	$6,263	$13,334	$14,828
State and municipal	13,700	12,929	23,807
Total Public	$19,963	$26,263	$38,635
Total private	5,240	8,684	7,573
Week's total	$25,203	$34,947	$46,208
Cumulative to date: 1932 .... $990,303	1933		$790,830

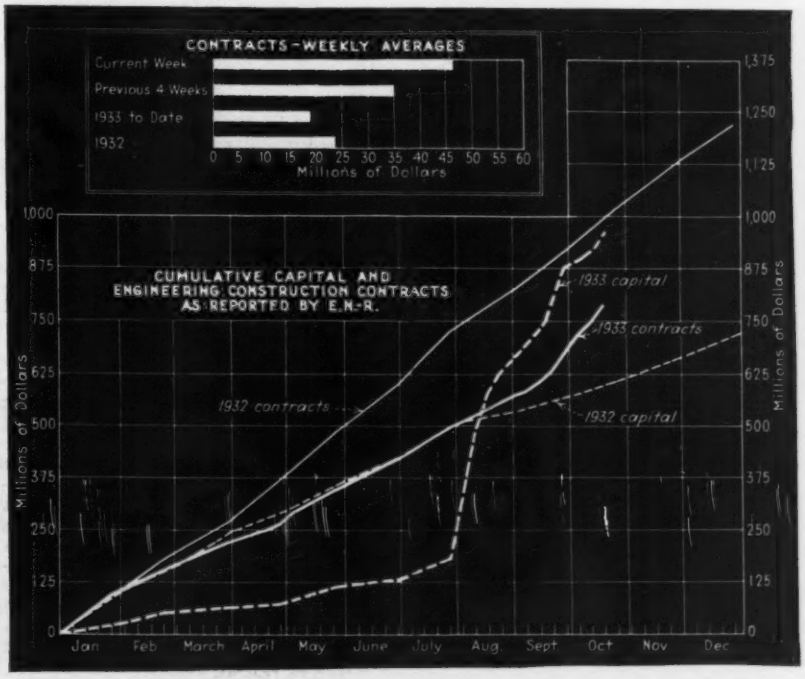
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

	Week Oct. 19, 1933	Cumulative, 1933
State and municipal	$ 7,724	$233,951
PWA allotments, public ..	38,543	641,619
Corporate issues	.....	46,347
PWA allotments, private .	4,588	46,573
Total new capital	$50,855	$968,490
Cumulative, 1932....	$602,750	

Note: These figures include private bonds and stock sold for productive purposes; state and municipal bonds for construction; R.F.C. advances for self-liquidating loans; PWA loans and grants to states and municipalities, including the special highway funds; and PWA private loans.

INDEX NUMBERS

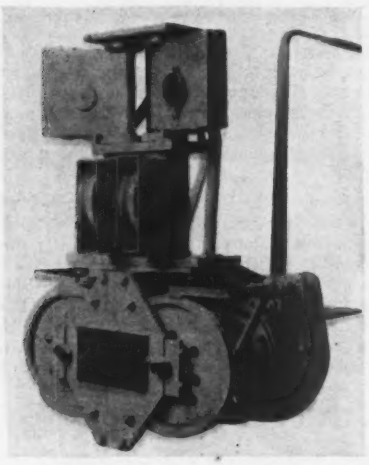
E.N.R.-Cost		E.N.R.-Volume	
October, 1933	187.74	September, 1933	122
September, 1933.	175.48	August, 1933.....	73
October, 1932...	159.16	September, 1932..	124
1932 (Average)...	156.97	1932 (Average)...	127
1931 (Average)...	181.35	1931 (Average)...	220
1930 (Average)...	202.35	1930 (Average)...	260
1913 (Average).....	100		


CONTRACTS-WEEKLY AVERAGES
Current Week
Previous 4 Weeks
1933 to Date
1932
0 5 10 15 20 25 30 35 40 45 50 55 60
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY E.N.-R.
1933 capital
1933 contracts
1932 contracts
1932 capital
Millions of Dollars
0 125 250 375 500 625 750 875 1,000 1,125 1,250 1,375
Jan Feb March April May June July Aug Sept Oct Nov Dec

Construction Equipment and Materials

Double-Drum Power Unit For Earth-Moving Equipment

A new and improved double-drum power unit has just been announced by R. G. LeTourneau, Inc., Stockton, Calif., manufacturers of heavy earth-moving equipment. The new unit carries more than twice the amount of line and has more than twice the amount of pulling power that the old LeTourneau double-drum unit possessed. It also has the lead sheaves above the



New power unit intended for operation of LeTourneau scrapers and tractor derricks.

drums instead of below, and has fair-leads on both lines so that they can be led in any direction.

The new equipment is intended for operation of LeTourneau scrapers and tractor derricks. It is also applicable for operation of any other equipment requiring two lines and, by leaving one line idle, for operating the bulldozers or other equipment requiring but a single line for operation.

As in the former type control unit, one lever controls each drum; pulling it one way releases the drum and allows the line to run out; pulling it the other way actuates the drum and reels in the line; releasing the lever locks the drum.

New Publications

Welding Equipment. Universal Power Corp., manufacturers of arc welders, 1719 Clarkstone Road, Cleveland, Ohio, have recently published bulletin 1056 on their shunt inductor welder-motor-generator sets, and bulletin 1057 on arc welding accessories and clothing.

Compressed Air. Ingersoll-Rand Co., 11 Broadway, New York, has issued a new catalog, entitled "Portable Compressors, Tools, and Equipment," which is designed to assist all users of compressed air. It describes and illustrates a wide range of machines and tools and lists the types of work for which each unit is best fitted. Recently developed products such as the two-stage, air-cooled portable compressor, the air-cooled stationary "Motorcompressor" and "Jackbits" are included, together with the complete line of I-R rock drills, paving breakers and pile drivers, drill steel sharpeners and oil furnaces, pneumatic tools, hoists, and boring machines. The catalog is designated as Form 1604E.

New Equipment in Brief

Oil Clarifier. The Briggs Clarifier Co., Inc., announces the Model H oil clarifier. It is a portable absorption refining unit connected directly to the crankcase of an internal combustion engine, and operating during the running of that engine. It is designed for use with either gasoline or diesel engines of less than 250 hp.

Diesel Locomotive. The Fate-Root-Heath Co., Plymouth, Ohio, builders of Plymouth locomotives, announce a new 10-ton diesel-powered locomotive. A 6-cylinder power plant is provided, of the solid-injection type, developing 95 hp. at 1,200 r.p.m. Two types of drives are provided: mechanical gear drive in sizes from 6 to 60 tons, and diesel-electric drive in sizes from 25 to 60 tons.

Water Pipe. A new type of water pipe made from a ternary lead alloy was exhibited by the British Non Ferrous Metals Research Association at the Shipping and Engineering Exhibition in London, held last month. These new pipes are made from alloys having a tensile strength 60 per cent greater than their lead equivalents, and weighing only two-thirds as much for pipe of similar capacity. The alloy is composed of lead, tin and cadmium, with sometimes the addition of antimony.

Air-Cooled Compressor. A new type of air compressor requiring no cooling water has been developed by Ingersoll-Rand Co., 11 Broadway, New York, N. Y. The new machine is called the motor-compressor and has a built-in motor. The motor frame is bolted directly to the compressor crankcase. The motor-compressor is a 2-cylinder, 2-stage machine, with cylinders and intercooler air-cooled. Units are built in sizes from 20 to 50 hp., with piston displacements from 113 to 310 cu.ft. per minute and for discharge pressures up to 125 lb.

Paver. A new dual-drum paver has been announced by the Ransome Concrete Machinery Co., Dunellen, N. J. The company states that the new paver has an output of from one-half to two-thirds more than the standard paver. The new machine has two standard-size drums built end to end. A power operated transfer chute passes the concrete from the first drum into the second. The dual drum has the same overall dimensions as the drum of a standard paver except that it is longer and a longer boom may be used.

Lubricant. Announcement has been made by the Armite Laboratories, 1450 East 61st St., Los Angeles, Calif., of a new lubricant in which metallic lead is the protective element. The lead has been broken down into such finely divided parts as to be virtually a soluble or liquid lead within a lubricant vehicle. The new product is known as Bestolife. It forms a thin protective film of lead on all contacting surfaces. It is claimed that the lubricant will withstand temperatures up to 430 deg. and will not entirely lose its lubricating stability until the melting point of lead is reached, or 590 degrees.

Business Notes

FERRO ENAMEL CORP., Cleveland, Ohio, manufacturers of porcelain enamels for metal products, have added a building department to their business, to be in charge of R. T. Hendrich.

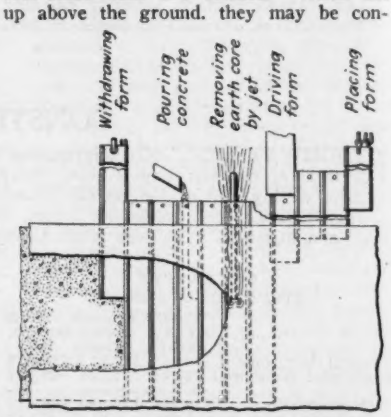
PENNSYLVANIA-DIXIE CEMENT CORP. has announced the appointment of W. H. Klein as general operating manager of all the corporation's plants, with headquarters at Nazareth, Pa.

JEFFREY MANUFACTURING CO., Columbus, Ohio, announces that the entire patent, manufacturing and selling rights for all devices heretofore manufactured and sold by the Traylor Vibrator Co. of Denver, Colo., have been acquired by the Jeffrey Manufacturing Co.

EVERETT SUTCLIFFE, vice-president of Warren Bros Co., of Boston, Mass., has been elected president of the new National Bituminous Pavers' Industrial Association, formed to operate under the NIRA.

New Forming System For Subsurface Concrete

A new method for forming concrete structures underground has been evolved and patented by Harry B. Arden, 54 West 94th St., New York City. The method consists of using steel forms made from commercial shapes, such as steel sheet piling, channels and angles, riveted or welded together to provide the desired combinations. The forms are usually made with three sides, two steel sheet piles held parallel to each other by a channel, riveted or welded to the inner sides of the piles. When these three-sided forms are interlocked with each other, four-sided cells are formed. When set up above the ground, they may be con-



Sequence of operations includes driving forms, removing earth core, pouring concrete and withdrawing forms.

secutively driven or jetted into the ground to the desired depth.

When in place the interiors are jetted clear of earth, after which pouring takes place. Immediately after the cell has been filled with concrete, the form is withdrawn, allowing the fresh concrete to unite with that in the adjoining cell to form a monolithic structure between vertical contraction joints. By providing interlocks on the sides of some of the forms, buttresses or extension walls may be run from either side. By using two piles of unequal width in some of the forms, a curved wall may be constructed.

Mr. Arden states that as there are many combinations that may be built up, it is possible to construct foundation piers and foundation walls for buildings, core, curtain and barrier walls for levees, earth dams, underground stream checks and barriers to beach errosion.